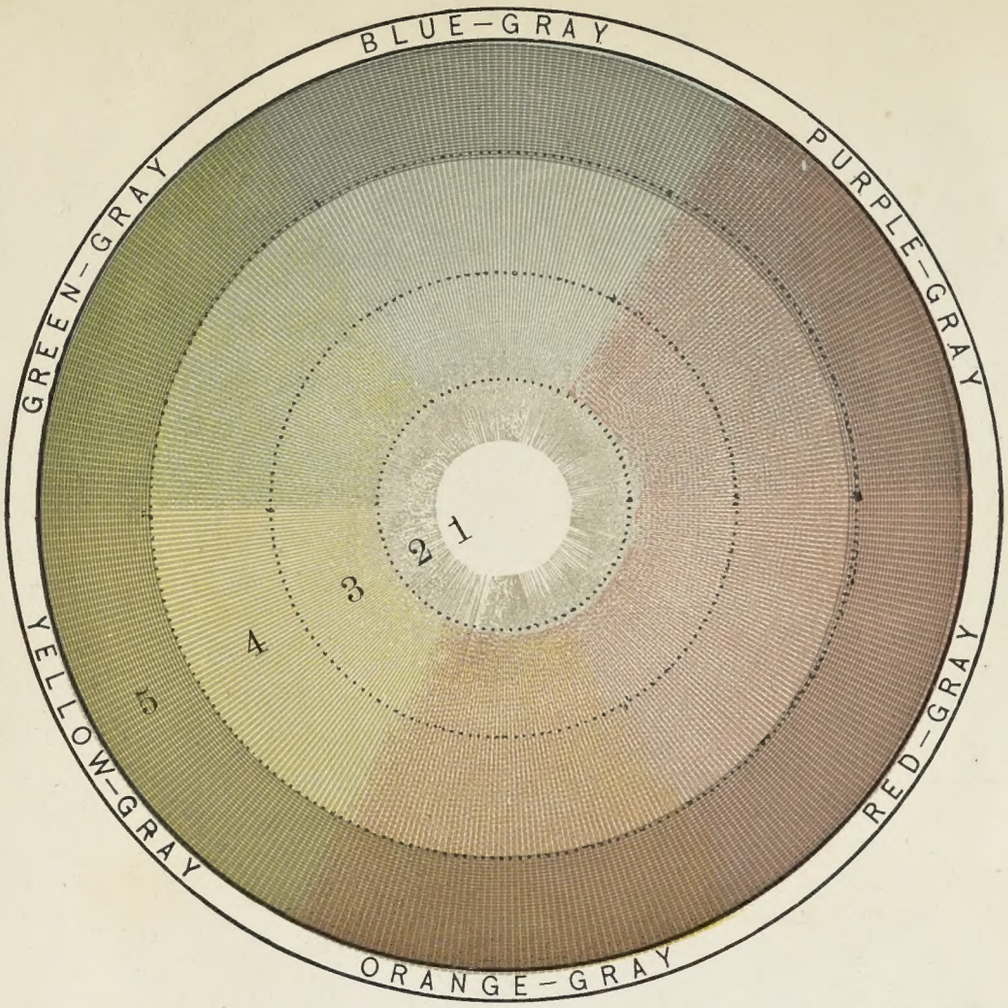
The Principles of Light and Color.

By

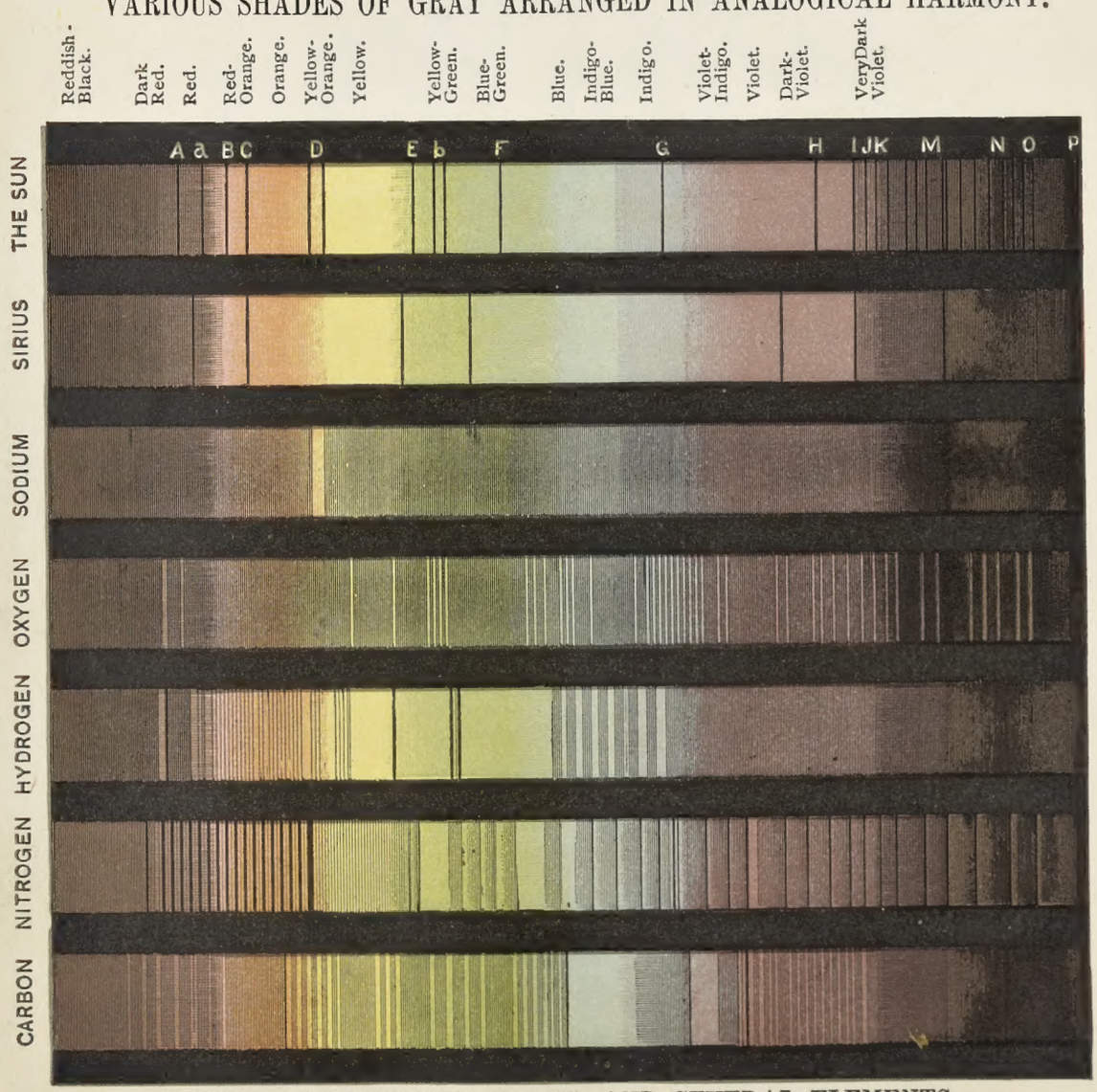
EDWIN D. BABBITT.



BABBITT'S PRINCIPLES OF LIGHT AND COLOR.—PLATE I.

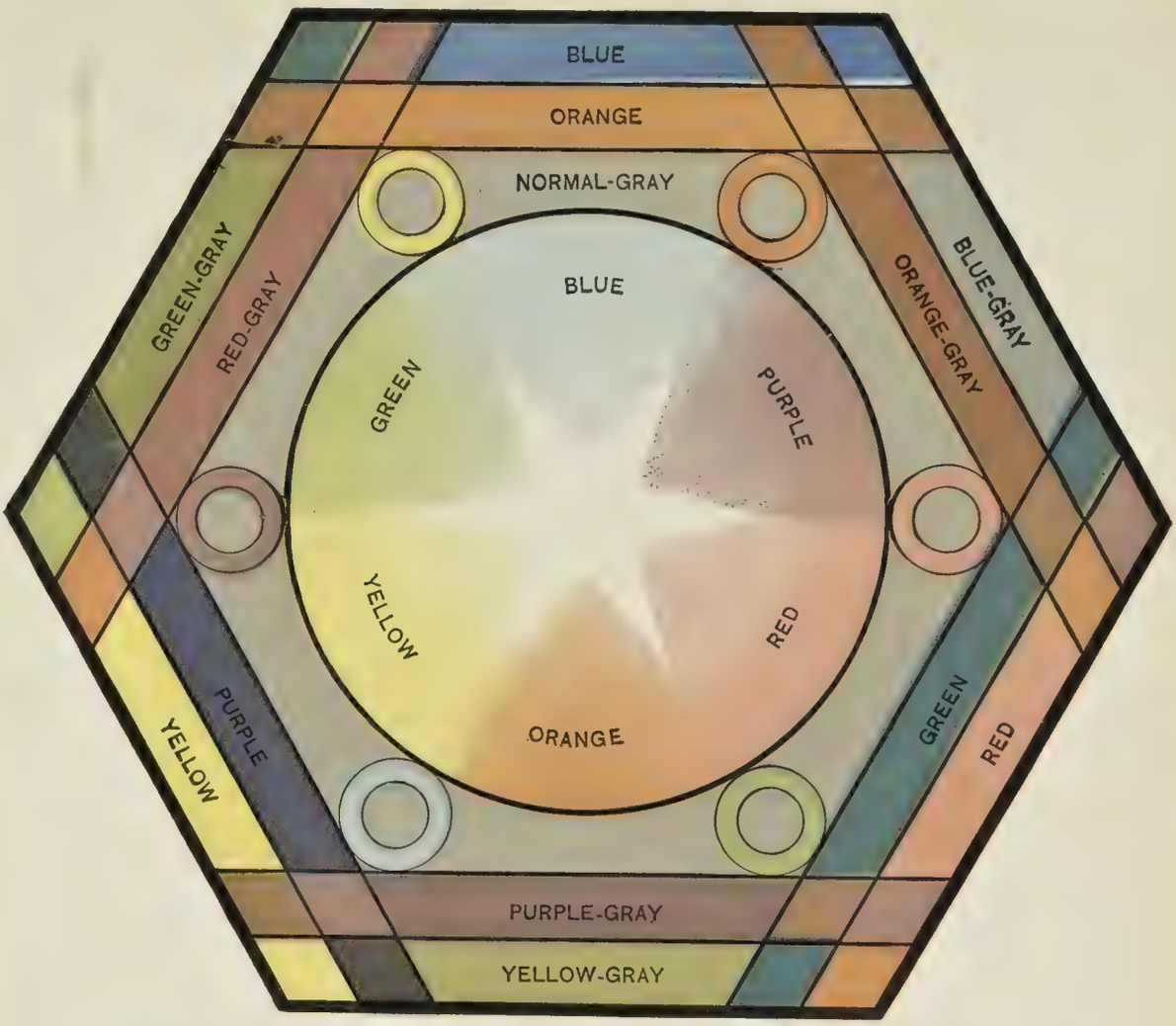


VARIOUS SHADES OF GRAY ARRANGED IN ANALOGICAL HARMONY.



SPECTRA OF THE SUN, SIRIUS, AND SEVERAL ELEMENTS.

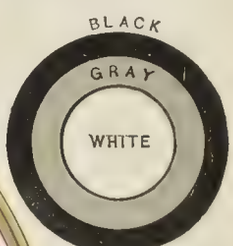
BABBITT'S PRINCIPLES OF LIGHT AND COLOR.—PLATE II.



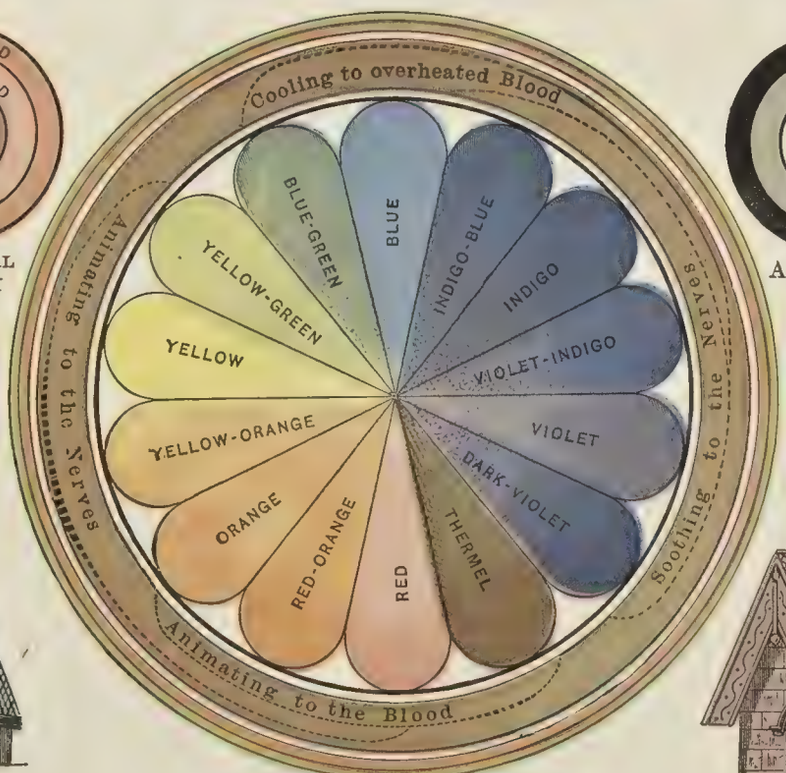
CHROMATIC HARMONY OF GRADATION AND CONTRAST.



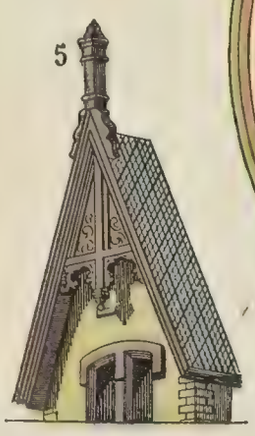
ANALOGICAL HARMONY



ACHROMATIC COLORS



5



CONTRASTING HARMONY

CHROMATIC COLORS PLACED OPPOSITE THOSE WHICH FORM A CHEMICAL AFFINITY WITH THEM

6



ANALOGICAL HARMONY

In the above elaborate combination of colors the artist has found it impossible to get every feature accurate, although he has many beautiful and pure tints. The grays on both plates I. and II. are not sufficiently subdued, the chromatic colors standing out too brilliantly, the red, for instance, in the house, fig. 6, being too strong, etc. For description of plates see pp. 63, 65, 66, 69, 71, etc. The spectra are described on p. 217.

THE

PRINCIPLES

OF

LIGHT AND COLOR:

INCLUDING AMONG OTHER THINGS

THE HARMONIC LAWS OF THE UNIVERSE, THE ETHERIO-ATOMIC PHILOSOPHY OF FORCE, CHROMO CHEMISTRY, CHROMO THERAPEUTICS, AND THE GENERAL PHILOSOPHY OF THE FINE FORCES, TOGETHER WITH NUMEROUS DISCOVERIES AND PRACTICAL APPLICATIONS.



ILLUSTRATED BY 204 EXQUISITE PHOTO-ENGRAVINGS, BESIDES FOUR SUPERB COLORED PLATES PRINTED ON SEVEN PLATES EACH.

By EDWIN D. BABBITT.

"Study the Light; attempt the high; seek out
The Soul's bright path."—*Bailey.*

NEW YORK:
BABBITT & CO.,
SCIENCE HALL, 141 EIGHTH STREET.
1878.

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1878.

THE GETTY RESEARCH
INSTITUTE

PREFACE.

THE preface of my work is like a Hebrew book; it begins at its very end. Having spent several years in developing this large volume, what is my excuse for thrusting it out upon mankind? None at all unless human knowledge and upbuilding can be enhanced thereby.

Am I laboring under a vain delusion when I assert that no science whatever, excepting pure mathematics, has thus far reached down to basic principles—that in spite of the wonderful achievements of experimental scientists, no definite conceptions of atomic machinery, or the fundamental processes of thermal, electric, chemical, physiological or psychological action have been attained, and that because the correlations of matter and force have been misapprehended? If I am deluded and cannot depend upon the thousand facts that seem to sustain me and clear up so many mysteries, it is certainly a sad matter, for then no one will be made the wiser for my labors; if I am right, and so many scientists are wrong in their conceptions of force, then too there is a melancholy side to the question, for great will be the trouble of having to pull up old stakes and put down new ones, and some opinionated persons will be so indignant at having dear old beliefs attacked, that if unable to demolish my facts in fair discussion will present one-sided views of them, or attack the author himself. I hope and pray that I may be duly abused, however, by all such crystallized conservatives, otherwise it will show that my efforts to advance this great cause of truth have been but feeble. After all, if this work shall develop some new and better foundations of scientific truth, scientific men themselves should rejoice at it even if it does cause a little trouble to adjust themselves to new conditions, for the more truth they get, the more luminous and triumphant will their pathway of progress become, and they will be able to build a superstructure upon these new foundations that is far more magnificent than any which my own limited efforts could achieve.

My discovery of the form and constitution of atoms, and their working in connection with etherial forces to produce the effects of heat, cold, electricity, magnetism, chemical action, light, color, and many other effects, was announced during our centennial year, 1876, in some New York and Chicago papers, and my ideas have been brought to still further maturity since. Having acquired this knowledge, it seemed quite possible at last to crystallize the subjects of

Light, Color, and other Fine Forces into a science, and learn their chemical and therapeutical potencies as well as many of their mystic relations to physical and psychological action.

Before reaching out into the unknown and invisible it was important to establish briefly the laws of the known and visible, the misapprehension of which has led scientists into various errors, as it seemed to me, hence my first chapters. Before being able to understand Light and Color, with any exactness, it was absolutely necessary to investigate the working of atoms, and the general laws of the fine forces, so that we may not always have to move in the dark when considering them. Hence my chapter on the Etherio-atomic Philosophy of Force. Whatever may be thought of my details of atoms, it seems quite impossible that a thoughtful mind should dispute the correctness of their general features, so absolutely capable are they of being demonstrated by facts.

It is quite time that the wonderful world of light and color which is invisible to the ordinary eye, and which is capable of being demonstrated by spectrum analysis and otherwise, should be made known, especially as so many mysteries of nature and human life are cleared up thereby, and such marvelous powers of vital and mental control are revealed.

I would especially ask one favor of all critics, which is, that they will examine and weigh well all departments of the work before they condemn, for it has cost too much thought and careful investigation to have it rudely and hastily passed upon. Comprising, as it does, so large a field of heretofore untrodden ground, there certainly must be some errors in spite of all my great care and desire for exact truth.

I have chosen a diluted sky-blue tint for my paper, not only because it is soothing to the nerves of the eye, but as I deem it, handsome. Calendered white, or yellowish paper is known to be irritating to the retina.

The beautiful engravings of this work, many of which have the steel plate finish, have been executed by the sun under the control of the Photo-Engraving Co., 67 Park Place, N. Y. For the very careful and conscientious labors of this company I am greatly indebted. The Superintendent, Mr. J. C. Moss, was the first, I believe, to bring these finest solar relief plates into practical use.

I owe a word of acknowledgment also to Mr. John Fahnestock, of 25 Rose St., N. Y., for the colored plates, which for beauty I have not seen surpassed on either side of the ocean.

EDWIN D. BABBITT.

SCIENCE HALL, N. Y.

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CHAPTER FIRST.

HARMONIC LAWS OF THE UNIVERSE.

I. Light.

Light reveals the glories of the external world and yet is the most glorious of them all. It gives beauty, reveals beauty and is itself most beautiful. It is the analyzer, the truth-teller and the exposer of shams, for it shows things as they are. Its infinite streams measure off the universe and flow into our telescopes from stars which are quintillions of miles distant. On the other hand, it descends to objects inconceivably small, and reveals through the microscope objects fifty millions of times less than can be seen by the naked eye.* Like all other fine forces, its movement is wonderfully soft, and yet penetrating and powerful. Without its vivifying influence vegetable, animal and human life must immediately perish from the earth, and general ruin take place. We shall do well, then, to consider this potential and beautiful principle of light and its component colors. for the more deeply we penetrate into its inner laws, the more will it present itself as a marvelous store-house of power to vitalize, heal, refine and delight mankind.

II. Nature our Guide.

1. But light is one of the fine forces of nature, and we cannot understand it until we learn the laws of the fine forces generally. Nor can we understand the fine forces themselves, until we become acquainted with the coarser elements upon which, or in connection with which, they act. And we cannot apprehend this interrelation of the finer with the coarser, without a knowledge of the fundamental principles of force, and the great central harmonic laws of nature and mind in unison with which all things

* A London Optician has constructed a lens which will magnify fifty million times.

must work. There has been too much mere superficial presentation of these matters. Unless we can go beyond mere external phenomena to basic principles, we must still build upon conjecture and work more or less in the dark. It is proper, then, that we should inquire into the general constitution of the universe, and get a clear conception of universal law before we can go with entire correctness into the details of any subject whatever, just as it is important to consider details, more or less, before we can comprehend the whole.

2. Why should we thus go to nature as the standard of ultimate appeal? First, because we are a part of nature and amenable to its laws; 2dly, because nature bears the stamp of divinity upon it, and therefore its laws are perfect. Is it consistent for the theologian to disparage nature so long as he admits that its source is that of absolute perfection.* Can imperfection ever come from perfection? Do not effects ever resemble their cause? To gain a knowledge, then, of nature's laws is to acquire the perception of divine harmony, by the aid of which all science, art, social life, government and religion may be measured. Without this knowledge we may use many brilliant words, and indulge in the most plausible speculations, but this is merely to build upon the clouds instead of the eternal rock-work of truth.

3. Many writers of the present day are presenting noble glimpses of the real teachings of nature, among whom is Ruskin, who has opened many blind eyes. Chevreul, of France, discovered to the world the laws of contrast in colors, and many artists and scientific writers have been revealing rich lessons from the infinite treasure-house. It has occurred to me, how-

* The late Prof. Taylor Lewis, one of the prominent theological writers of the day, speaking of nature in the *N. Y. Independent* of Dec. 30, 1874, says:—"Our oracle may but mock us as Crœsus was mocked by the ambiguous answer of Apollo. Our deepest understanding of nature may bring us a new peril, requiring a new study. * * * It would almost seem as though there were some truth in the old legend that nature had been cursed for man's sake." Thus illogically talks this scholarly gentleman about the peril of studying the workmanship of him who, as he admits, is the Divine Perfection. The only danger lies in ignorance of these laws, and to see danger in them is to look superficially at the matter. Throughout all nature is such amazing system, such law, such unity in the infinite diversity, such simplicity in the midst of complexity, that it is not difficult to understand its fundamental principles, if we can only bring to the task minds which are not preoccupied with old theories.

ever, that some more definite crystallization of principles may be arrived at, and with the reader's permission I shall now pause for a little time in making the attempt to arrive at these fundamental harmonies of things, so that we may go with open eyes into these marvelous fields of the fine forces, and also be the better able to regulate our art as well as our science.

III. Unity.

The Law of Unity is universal through all matter and mind, and is the expression of wholeness, oneness, centralization and organization.

1. Unity exists in absolutely all unimpeded natural growth, and as we have seen that nature's development is on the law of perfection, we may be sure that unity is a universal harmonic law. The different methods by which nature expresses unity are almost infinite in number. Being a law of vast importance, a few examples will be given.

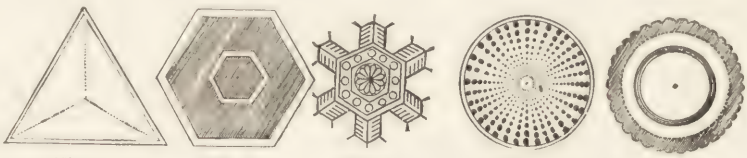


Fig. 1. Triangle. Fig. 2. Fig. 3. Snow Crystals. Fig. 4. Fig. 5. Microzoa.

Fig. 1 is a *triangle*, a form common in many crystals, and when equilateral, has three points at the angles and three at the sides, which have a common center of unity. Fig. 2, the *hexagon*, so common in crystallization, has twice as many points of unity; fig. 3 has many more points than fig. 2, each projecting line being a point of unity for other lines, while the figures of the animalcules, 4 and 5, which are but examples of countless millions of amazingly minute skeletons of animals out of which whole mountains are sometimes built, have an unlimited number of points of unity, the circle itself being a figure which is defined as being composed of an infinite number of straight lines, which are equidistant from the same center. Fig. 6 has a general center of unity for a variety of fibres which



Fig. 6. Fig. 7. Leaves. Fig. 8. Echinus Shell. Fig. 9. Star Fish. Fig. 10. Flowers.

branch out from each side. Fig. 7 has several centers of unity which meet at a general center. Fig. 8, a shell of Echinus, forms a little dome-shaped animal with a great variety of lines of forms which have their center of unity at the apex. Fig. 9 presents a few of the radiating lines of the *asterias*, which has a flower-like center. Fig. 10 shows how the leaves and other parts of flowers affectionately meet at a center of unity. When the cactus blossoms it is said to have an array of five hundred stamens which encircle the pistil as its center of unity.

2. *Leaves* and other natural *forms* not only have centers of unity in themselves, but their very contour is apt to give a portion of some other beautiful outline with centers outside of themselves, as seen in fig. 11. While the fibre 1, 3, forms the general center for the other parts of the leaf, its graceful outline 1, 2, 3, or 1, 10, 3, describes the *line of beauty* which consists of a part of two *elipses*, or rather of two *ovals*, which latter have two unequal centers of unity instead of two equal centers like the ellipse. I have dotted out the ovals, arcs of which are included in a single side of the leaf. Fig. 12, consisting of leaves of the castor-oil plant, presents one general center, seven sub-centers, and a large num-



Fig. 11.



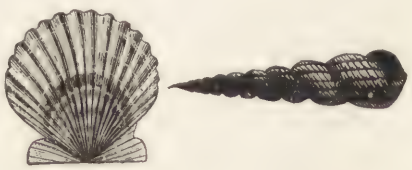


Fig. 12. Ricinus Communis. Fig. 13. Scollop Shell. Fig. 14. Spiral Sea-Shell.

ber of still smaller centers of unity and many outlines. Fig. 13

has a general point for a system of both radiating and concentric lines. Fig. 14 has the *line of grace* which winds around a general center of unity, and has also the unity of parallel lines, etc. Figures 15, 16, 17 and 18, illustrate various styles of unity in foliage and tree growth, and are taken from Ruskin's "Elements of Drawing." The methods of unity in the combinations of leaves, branches and trees are beyond all computation, and I simply give a few examples to get the reader to notice a great truth which all nature proclaims. "The number of systems," says Ruskin, "is incalculable, and even to represent anything like a representative number of types, I should have to give several hundreds of figures."



Fig. 15. Fig. 16. Fig. 17. Fig. 18.



Fig. 19. Daisies, Grasses, etc.



Fig. 20. Trees at Mount Vernon.

3. Notice how many varieties of unity are presented in a simple *cluster of leaves*, grasses and flowers, as in fig. 19. Not only have these objects many styles of unity when taken singly, but in spite of all their seeming lawlessness they have a general harmonic unity of direction, growing, like trees as a general law,

in a vertical direction, and hence more or less parallel to each other.

4. I will now present a whole world of unities within unities in a beautiful *tree cluster* which grows by the tomb of Washington at Mount Vernon. (Fig. 20.) Here the trunks of the trees may be seen as the centers of unity for the branches, the branches as centers for still smaller branches, and these for kingdoms of foliage growing less and less in size until we reach a single leaf, which after all is a miniature realm of itself, having organizations within organizations.



Fig. 21. The Nervous System.

5. The *human system* contains thousands of centers of unity, among the most important of which are the brain and spinal column as the general center of the nervous system (fig. 21), and the heart as the general center of the vascular system.

6. *Crystallizations* have their innumerable centers of unity.



Fig. 22. Dissection by sunlight of a block of ice and its crystalline structure shown.

Fig. 22 shows some of the elegant crystalline forms of a block of ice as dissected by the solar rays in an experiment made by

Mr. Tyndall. Snow abounds in the most elegant crystals, generally hexagonal, or at least arranged in six projections, which are just 60 degrees apart, as is the case with ice. But crystalline forms are too numerous to even hint at.

7. *Forces* of all kinds in nature, when unrestricted, move according to absolute laws of unity. Gravitation makes it impossible for any object to exist without a tendency toward some more powerful object, all objects on a planet, for instance, tending toward its center, and all planets tending toward their parent suns, their tendency, however, being balanced by their centrifugal or projectile motion. In fact the unities of form already given result from some principle of unity in *force*, as will be seen hereafter. Fig. 23 shows some of the billions of lines of force which encircle a *magnet* as their center, shown by iron filings on card-board above a magnet, as well as some of the straight lines which pass through the bar itself as a polarizing center. Figs. 24, 25, 26, 27, 28, show nodal lines of vibrating circular or polygonal plates according to Chladni and Savart. These plates are sprinkled with dry sand, and may

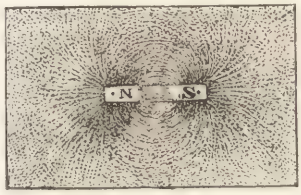
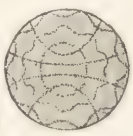


Fig. 23. Magnetic Centers of Unity.


Fig. 24. Triangle.


Fig. 25. Circle.

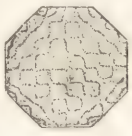
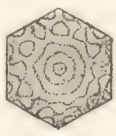

Fig. 26. Octagon.


Fig. 27. Circle.


Fig. 28. Hexagon.

be vibrated by a violin bow under different circumstances, under all of which they develop some principle of unity as signified by the forms of the sand, and show how wonderfully nature's freest operations are developed according to law.

8. All *vibrations*, all *undulations*, all *motions of falling* or *projected bodies*, move according to some mathematical law of unity, such as the curve of the parabola, the circle, the oval, or generally some other section of a cone.

9. *Verse* and *musical composition* have a unity in the length of steps, called rhythm; *melody* demands some ruling tone,

called the key note, around which the other notes cluster as their element of unity ; *logic* lays down its central idea or proposition, and either reasons from external points toward this center (a posteriori), or from this center toward external points (a priori), and all true art must crystallize its esthetic jewels upon some thread of unity.

10. All *light* emanates in untold millions of rays from some center of unity, such as the sun, a gas burner, etc.

11. All *colors* combine in a wonderful unity to form white light, and even when separated by a prism or by a rainbow, they blend so perfectly as seemingly to constitute a single band of hues.

12. *Gravitation* binds the whole physical universe into oneness of law and oneness of existence, and is everlastingly bringing all objects toward some central point by its infinite chains of power. *Cohesion*, dealing with atoms, binds solids into a firm unity of mass, and rolls up fluids into little spheres, each of which has its center of infinite points. Gravitation, however, binds all atoms and all masses of atoms into one family, first chiseling out all worlds into beautiful globular shapes and then tying them together. By its means the sun becomes a center of unity for 137 planets, moons and asteroids,* as well as for comets, which are so numerous as to be estimated by millions. The following remark by Guillemin will show that the sun, mere point as it is compared with the universe, has after all a vast reach into space : "Whereas the radius of Neptune's orbit is equal to 30 times the mean distance from the sun to the earth, the aphelion of the comet of 1844, whose period is 100,000 years, is lost in extra planetary space at a distance 4000 times as great."

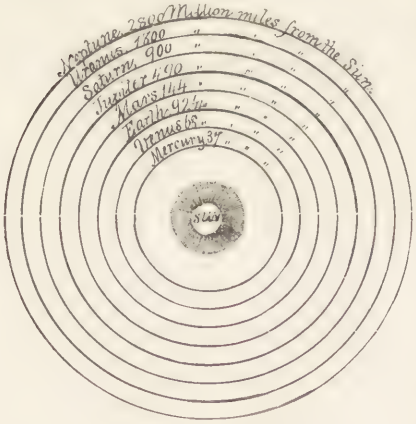


Fig. 29. The Solar Family.

* This includes the two moons of Mars lately discovered; but new asteroids are being looked up yearly, and the above estimate will prove too small.

13. The star *Alcyone*, in the Pleiades, is supposed by many astronomers to be the mightier sun which forms the center of unity for our own sun and a great number of other solar systems.

14. To show that the universe follows this law of unity in the large as well as small, I will give a few star clusters, sometimes called nebulæ, as seen by Sir John Herschel. I would first remark that our own solar system is situated in the vast cluster called the Milky Way, which William Herschel, aided by his telescope, estimates as composed of 18,000,000 stars. If Alcyone is the center around which move our own and many other solar systems, it is reasonable to suppose that the Milky

Fig. 31.



Fig. 30. Fig. 33. Fig. 32.

Way itself has some vast center around which Alcyone and all the other stars of this immense cluster make their almost infinite circuit. Otherwise how could they be held in a mass separate from the rest of the universe? But all stars seem to be situated in some cluster, and held there by a law of unity with the other stars. These clusters are counted by thousands. In the Constellation Virgo is what seems to the naked eye to be a small star called ω (omega) Centauri, but when viewed through a large telescope proves to be a magnificent globular cluster of thousands of stars, represented by fig. 30. These globular clusters are very common. Fig. 31 simply gives the central portion of a spiral nebula in the lower jaw of Leo, the whole of which is supposed to contain millions of stars. There must have been

a center of amazing power around which inconceivably vast whirlwinds of force swept this array of stellar systems. Fig. 32 is an oval nebula in the constellation Vulpecula, the brightest part of which resembles a dumb-bell. Fig. 33 is a nebula in Gemini near the bright star Castor, with rings and a star in the center.

15. But have we reached the ultimate of the law of unity in these thousands of star clusters, each of which is almost a universe in itself in its immensity? Is there no omnipotent, ubiquitous bond of unity which binds even these clusters of solar systems into one almighty center which "we call God and know no more? (Derzhavin.) If not, then all analogies fail and all attempt to arrive at universal law is a mockery, for we see that the principle of unity is absolutely universal, whether we progress toward telescopic or microscopic infinities.

16. But the unity of the material universe is not all. The common supposition that spirit is wholly unlike matter, in other words is *immaterial*, is quite superficial; for if there were no bonds of unity between the two, spirit could never act upon matter nor matter upon spirit. The teaching of such absurdities drives logical minds to the denial of all spirit, and the advocacy of materialism and atheism. It should be understood that the very same laws rule in the spiritual and intellectual phases of being as in the material; in other words, *unity of principle rules in every department of the universe and binds the whole in one.* Mankind intuitively understand this, and constantly express it in their language, using such expressions as "*heat of passion*" and "*heat of fire;*" "the *light of knowledge*," as well as the light of the sun; "*harmony of colors and sounds*," as well as *harmony of feeling.* A person is spoken of as having a "*cool, reasoning style*" *of mind*, while another is said to have a "*warm and loving heart.*" The eyes are talked of as "*flashing fire*," as, for instance, a New York paper speaks of Verdi, the composer of Trovatore, as having "fiery, flashing eyes." Words are said to *burn*, the heart to "*boil with indignation*," and so on. In the chapter on Chromo-Mentalism, it will be shown that mind and body work after precisely the same laws; that the eye can flash real fire, only it is of a higher grade than ordinary fire; that the process of reasoning is attended with blue emanations

from the front brain, which may be seen by certain persons, and as the blue is the cold principle in colors, we see that it is literally exact to speak of a "cool, reasoning mind;" that the impulsive and loving processes are attended with red emanations, and as red is the principle of heat among colors, we are absolutely correct when we speak of the "warmth of love" or the "heat of passion," and are not using figurative words; that when we say the "heart boils with indignation," we are literally correct, as heat of the spiritual forces causes a hot condition of the heart which sends the blood into a boiling motion, and that there is a chemical affinity ruling in the psychological and etherial forces just as absolute as that which works in physiological and ordinary material conditions, will be abundantly shown hereafter. Unity, then, being thus ubiquitous in all realms of matter and force, we may be guided by the following rule:—

All things in their basic principles resemble all other things, and we are safe in judging of the unknown by the known, of the invisible by the visible, and of the whole by a part.

Great and important as is this law, and giving us as it does a key to the mysteries of things, we come now to another law which is equally important and without which all harmonious unity itself is impossible.

IV. Diversity.

Diversity is a universal law of nature, and exemplifies freedom, life, individuality, infinity, etc.

In other words, nature consists of infinite unity differentiated into infinite diversity. The reader will now please review all the engravings which illustrate unity, and see how absolutely they also illustrate diversity, otherwise they would have been a perverted style of unity quite contrary to all free natural development. In the triangle, fig. 1, we see lines moving in three directions; in fig. 2, lines moving in six directions; in fig. 3, the diversity is far greater; in fig. 4, we have the circle which, geometrically speaking, consists of an infinite number of straight lines, and we have also diversity in the size of the dots; in fig. 5, we have a variety of circles and arcs of circles; in figs. 2 and 5, we have also a diversity caused by light and shade; in the

illustrations following, diversities of form, of size, of direction, and of color. In all foliage the outline and color of the leaf and the size and direction of the fibres and texture are a constant source of diversity. Trees afford a remarkable diversity of direction, size and color of their branches and sub-branches, and leaves, bark, flowers, fruit, etc., as well as in the light and shade of their different parts. In short, the earth and man—the land, and sea, and sky—are rich and delightful in their infinitude of forms, and sounds, and colors, and motions, while the world of literature and spiritual power is richer than even the outward world.

V. Harmony.

Harmony consists in the equal balance of Unity and Diversity, and this harmony is increased in exquisiteness in proportion to the number of these parts of Unity and Diversity

1. In other words, organization and individual freedom must be combined. In fig. 1, we have three points of general unity, and three lines moving in diverse directions, to constitute the triangle. In fig. 2, we have twice as many points of unity balanced by twice as many points of diversity, consequently the hexagon is more beautiful than the triangle. On the same principle fig. 3 is more beautiful than fig. 2, and figures 4 and 5 than fig. 3, although fig. 3 is more spirited than these last mentioned.

2. Colors must combine this variety of tints, hues and shades on the law of unity to please. If we should see a daub of various colors on an object without any unity of law in their arrangement, taste would be offended, for it would be diversity



Fig. 34. Diversity without Unity.



Fig. 35. Unity without Diversity.



Fig. 36. Unity and Diversity combined.

run wild. If we should see only one color everywhere and always, it would be insupportable from its unvaried unity (see fig. 35); or if we should see light and shade mingled in a lawless manner on the plan of mere diversity, as in fig. 34, it would be equally distressing. The one would be well represented in a treeless, barren desert, or by a condition of absolute darkness, the other by a mass of ruins, or debris, while both would be a violation of the regular development of nature. It is a relief to turn from these to fig. 36, where freedom and law combined delight every eye.

3. *Chiaroscuro*, or the fine balance of light and shade, constitutes a most effective feature in art. Joshua Reynolds made a rule that one-third of a picture should be in shadow and two-thirds in light, but this would interfere with our rule, which requires, on the average, an equal distribution of opposite principles, such as light and shade. If light or shade predominates too much, the diversity is not sufficient to balance the unity, and the objects portrayed are less distinct and spirited than they should be. Take, for instance, fig. 37, in which an etching from Rubens is given, and although the features and expression are brought out by a master hand, yet the effect as a whole is much less brilliant than the head of the "Astronomer," fig. 38, presumably Galileo, which I copy from the London Art Journal, or rather which the potent beams of the sun have copied for me as they have also engraved the Rubens. In this way I get a fac-simile of both. It will be seen that the light and shadow are very finely distributed in the "Astronomer," the greatest light being on the face where nature has placed it, and the shadow being on the hair and beard where nature has also placed it, while the dark back ground brings out the light of the whole head by contrast. Diversity



Fig. 37. An Etching of Rubens.

is thus developed; but what is the principle of unity? The sameness of general tone throughout the picture, or so far as there is diversity of light and shade, such a gradation from one to the other as not to interfere with the oneness of effect. Swinging to the other extreme of too little shadow, as in fig. 39, we find the law of diversity lacking equally with the Rubens, fig. 37, and the same indistinctness of detail as in that picture. Both utility and beauty then require a balance of light and shade. Fig. 40 is a fac-simile of one of the ruder sketches of the brilliant artist Gustave Doré, showing the frightened Sancho Panza lying on the ground. The blackest shadow is made to fade suddenly into absolute light without the gradations which nature adopts, and the little patches of ground at the lower part of the engraving seem to stand out like islands by themselves, without any relationship to the ground on which he lies. Compare this



Fig. 38. The Astronomer. (Galileo.)

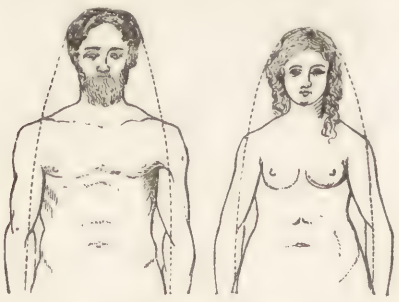


Fig. 39 Deficiency of Shade.



Fig. 40. Unity lacking.

to the engraving of the tomb of Plautus Lucanus, fig. 41, which has an effective display of light and shade. Every stone and piece of soil or other object stands out distinctly, and while

there is a fine diversity and gradation, there is also a general unity of spirit and tone throughout. In this picture it will be seen that the sun, though slightly in front of the bridge, must be nearly perpendicular, as the light does not pass under the arches. In fig. 42, however, the sun must be behind the bridge and near the horizon, judging by the distance that its rays are able to penetrate beneath it over the water, and by the dark shadows which it casts.



Fig. 41. Tomb of Plautus Lucanus.



Fig. 42.

4. But we shall hereafter see some great and distinctive methods by which light and shade and other principles are combined to constitute real harmony, which is the *golden mean* made up of the two extremes, rather than the golden mean between extremes. In all things that harmony which is the foundation of beauty, life, health, happiness and power, comes from the union of the two extremes of power, and these extremes generally find their type, if not their exact character, in unity and diversity. Some of these combinations are as follows :—

Light and *shade*, which are exactly balanced in nature, the nights and days having the same average length the world over.

Positive and *negative forces*, which must ever be combined equally to make smooth and perfect action.

Heat and *cold*, which are balanced in the temperate zones and over the world taken as a whole, but being blended one-sidedly in the torrid and frigid zones they cause more or less distress and interference with nature's harmonious processes.

Life and physical harmony are impossible without a balance of these two principles of heat and cold, heat being the principle of diversity and outward expansion, and cold the principle of unity, organization and crystallization, but either one being destructive if alone.

Sweetness and *acidity*, as combined in strawberries, peaches, apples, lemonade, etc., or *sweetness* and *bitterness*, as combined in coffee, tea and many other substances, set into motion that harmonious flow of forces through the organs of taste which lead us to call them luscious or delicious. They delight the physical taste. Unity and diversity, as combined equally, especially on the law of Gradation or Contrast, which I shall now proceed to explain, reach a more spiritual part of our nature and delight the esthetic taste, as in the beautiful or sublime. It is plain, then, that when we reach basic principles they apply to every department of the universe, including both matter and mind.

VI. Gradation or Progression.

1. There are two great leading and distinctive methods of combining unity and diversity for the production of harmony, common through universal nature and of course through all correct human art, which should be a mirror of nature, namely, Gradation, whose characteristics are exquisiteness, progression, beauty, femininity, typical of the love principle, and Contrast, whose characteristics are spiritedness, decision, power, picturesqueness, sublimity and masculinity, typical of justice.

2. *Gradation consists in delicate degrees of progression from one quality or condition to another*, and nature's progressions, when unrestricted, are ever toward superiority of some kind. Thus in Æolian tones there are crescendos progressing toward superior power, and diminuendos progressing toward superior sweetness; in all leaves, fibres, branches, trees, flowers, etc., there are endless progressions toward superior size and power in one direction, and superior fineness and delicacy in the other, see figs. 4, 8, 9, 10, 11, 12, 13, 14, 16, 19, 20, 21, etc. In a sunset sky, the gradation is toward superior brilliancy as we move from east to west, and toward superior softness of color as we move from west to east; in the rainbow or solar spectrum, we

have another beautiful example of gradation or blending of colors, the progression being toward superior fineness, coolness and penetrating power, as we move from the red through orange, yellow, green, blue, indigo and violet, and toward superior warmth and animation as we move in the opposite direction. Examples of this gradation of colors may be seen in all of the colored plates of this work. I will give a few divisions of nature's infinity of gradations.

3. *Gradation of Size.* I have just mentioned a number of gradations of size as in the fibres, branches and leaves of plants, etc. The gradation of human limbs and features is especially beautiful. Trees abound in many styles of gradation. Fig. 43 shows the ordinary round-topped tree, such as the beech, the maple, etc., in which there is a progression in direction of



Fig. 43. Round topped-tree. Fig. 44. Oblong headed tree. Fig. 45. Spiry-topped tree.

the outline and progression in size. Fig. 44 is an oblong-headed tree, like the poplar, which has too little diversity in its progression toward a point at the top, and consequently its appearance is rather stiff. Fig. 45 is a spiry-topped tree, and includes in its class, cedars, firs, larches, etc. It is more attractive than the poplar, from its greater diversity of angles and forms, both angular and curved, and presents sharp contrasts of direction as well as its gradations. Fig. 46 is the spire in decorated Gothic of the Cathedral, corner of Fifty-first Street and Fifth Avenue, New York. It has a beautiful and gradual progression from top to bottom, that makes it far more graceful than the spire in fig. 47, which at a point a little above the roof widens so abruptly as to



Fig. 46.



Fig. 47.

make a contrast rather than a gradation. Such a spire may be called picturesque, but it is not graceful.

4. *Gradation of Direction,* is simply *curvature,* and curves are among the leading features of beauty in forms. I have given in figures 48, 49 and 50 three leading curves in natural forms and motions. Fig. 48 shows the beautiful curves of the parabola, such as are described by fountains, cataracts and all missiles thrown upward outside of a perpendicular line. Fig. 49 gives what the famous old English artist Hogarth called the *line of beauty,* and moves in two directions like the meandering of a stream or the form of undulations (see fig. 51). It may be seen in the forms of many grasses, leaves, flowers, shells, streams, etc., and is given in figures 6, 7, 11, 12, 13, 15, 16, 19, 20, 21, 37, 38, 39, 51, etc. Fig. 50 is called the *line of grace,* named also by Hogarth, and is a spiral. It is seen in the climbing of vines as they encircle a tree, in many sea-shells (see fig. 14), in curls of hair, etc. It is perhaps the most beautiful of all simple continuous lines, and, as will be seen hereafter (chapter III.), is the most common form in the universe. It not only has a leading center for the whole form, but is composed, geometrically speaking, of an infinite number of circles as points of both unity and diversity. Undulations not only progress in size but in delicacy of form as they advance. The fern branch, fig. 52, has not only gradation of size as a whole, but of each branch and part of a branch, and has also many gradations of direction. Fig. 53 consists of gradations of gradations, which are formed by superposing compound sounds on simple sounds and causing their vibrations to be recorded in lamp-black by a graphic instrument



Fig. 48. Curves of the Parabola.



Fig. 49. The Line of Beauty.



Fig. 50. The line of Grace.

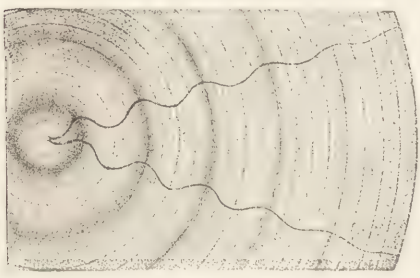


Fig. 51. Undulations.



Fig. 52. A Fern.



Fig. 53. Vibrations of compound sounds.



Fig. 54. Combination of two parallel vibratory movements.

devised by Savart. Fig. 54 has gradations of size and direction, and was written in lamp-black by a combination of tuning forks. Fig. 55 is an example of progressive rings of colored light, which were produced by electricity, as seen and drawn by an artist and quoted by Dr. Jerome Kidder of New York, in his pamphlet on Electro-Allotropo-Physiology :—"Placing the sponge of an electrical machine to my left eye, and making the current strong, I saw stars in about four seconds. Rings vibrating came from the ends, growing weaker as they approached the center, where they died out entirely. This was very beautiful. It commenced with yellow at the first ring, at about the fourth or fifth ring they became red, and disappeared in a faint blue." It will be noticed that these waves of light progress in size, in thickness, in color, and in direction of outline according to the line of beauty, and have a general unity as a whole, as well as a special unity of breadth, of parallelism and of a common center, while the features of diversity are equally marked.



Fig. 55.

5. *Gradations in the Human Form.* The human form being the highest development of the external universe should have the highest manifestations of harmonic features. It may be remarked, first, that the contour of a mature and graceful countenance, as well as of the top head, is on the plan of the oval, while the unripe period of infancy and early childhood approaches the circle. The Romans advocated the circle as the highest form of beauty, while the more cultured taste of the Greeks preferred the ellipse, the oval and other sections of a cone. The circle is the stiffest of curves, in fact is a curve of limitation, while the oval may have a great variety of curved forms all of which have their centers of unity. Fig. 56 is an ovoid, or egg-shaped form, which has its center of gravity at G,



Fig. 56. An Ovoid.

within, but its general center of form around a line which should extend through the center of the whole ovoid longitudinally. I will now present some faces as illustrations of the principle.



Fig. 57. Emma. Fig. 58. Katie.

Figs. 57 and 58 are a copy from life of two sisters, who at the same age had a good deal of resemblance to each other. Emma is 18 months old and has fine round features. Katie is 6 years old and her features have become much more oval, the curve of the chin being more delicate and yet more marked as



Fig. 59. The Infant. Fig. 60. The French Market Girl.



Fig. 61. Childhood and Youth.



Fig. 62. Maturity: Genevieve.

compared with that of the cheek, while the hair contrasts more distinctly in color and prominence with the face. Figures 59 and 60 present subjects still younger and still older than those of Emma and Katie, the infant which I have copied from the London Art Journal having a face so nearly circular that its chin almost disappears; while the French market girl, having reached early womanhood, has a fine oval face and more distinct features of every kind. In fig. 61, the same principle is well illustrated in the three faces presented, which lengthen out as their age progresses, while womanhood, as represented by Genevieve in fig. 62, presents a still greater variety of gradations as seen in the curves of her form as well as greater contrasts. The line of beauty will be seen on her cheeks, top hair, shoulders and bust, and the lines of grace in her lower hair, although the artist has not given her a very superior expression of countenance.

6. *Gradations of Light and Shade* so beautifully exemplified in sky and hill and valley and lake, and in most of the manifestations of nature, must be imitated as far as possible in art. In most of the foregoing pictures these gradations are easily seen, especially in that of the Astronomer, fig. 38, in which the light fades into shadow as we pass from the forehead to the temples, or into still deeper shadow on passing to the eyes, which are overhung by his prominent and intellectual brow. This latter, in fact, may be called a contrast of light and shade, although it is graded

off so as to be quite refined in comparison with the rude masses of light and shadow in fig. 40, which are almost lacking in gradation.

7. We have already seen that *Gradation of Colors* appears in those that blend as in the rainbow, and that this gradation, although so diversified in its hues, has the property of binding a mass of colors into oneness or unity of effect, hence its beauty.

8. In the *Motions and Forces* of Nature, gradation seems to be a universal law, extending to gravitation, chemical affinity, etc. All projected or falling bodies, all movements of suns, planets, moons and comets forever progress either with increasing or retarded velocities and momentum.

9. *Rhetorical* and *Musical Gradations* consist of those climaxes or passages of increasing power or sweetness which move on step by step until they culminate. In music, there are various dynamical, melodic and climacteric gradations such as crescendos, diminuendos, curves of the voice, upward or downward movements of the voice, etc., all of which, when on the law of gradation, are beautiful. In rhetoric it is often said that climaxes are beautiful, but that it is impossible to tell the reason. It is very easy to see the reason when we remember that a climax is simply a progression or gradation of ideas in harmony with nature's universal law of beauty. Fine rhetoricians are ever apt to arrange the clauses of their sentences in an increasing gradation, and when this is attended with increasing importance of ideas, it becomes doubly effective. I will give only a single passage from Burke:

> There is one thing
> and one thing only,
> which defies all mutation:
> that which existed before the world,
> and will survive the fabric of the world itself,
> I mean JUSTICE, etc.

10. *Miscellaneous Gradations.* I have given my last paragraphs partly to show that a unity of law exists in the world of intellect and language as well as in external nature itself. The same law of gradation could be traced all through refined social life, through government, through religion and through every department of nature, mind, and art.

VII. Contrast.

Harmonic Contrast combines Unity and Diversity in bold degrees or in distinct masses.

1. *Contrast of Direction* consists of straight lines and acute *angles*, just as gradation of direction consists of curvature. These right lines and bold angles are generally attended with power, sublimity, spiritedness, or picturesqueness, as is the case with flashes of lightning (see fig. 63), or great cliffs, or storm-tossed billows, or lofty cataracts. In fig. 64 the bold angles of the cliffs, the dash of billows, the lowering clouds and the lightning's track all betoken great power, are especially sublime, and are manifestations of contrast. The contrast of light and shade which the artist has represented adds to the spiritedness of the scene.

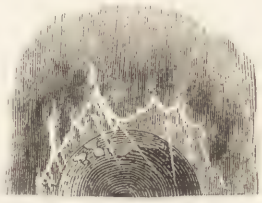


Fig. 63.



Fig 64. Beachy Head.

2. We shall see the distinction between *gradation* and *contrast* all the better by means of fig. 65, in which the graceful predominates everywhere from the curvature and other gradations that rule, including the bridge with its vases, the winding drive and walk, the arched pavilion, the flowing foliage, and flowers, the placid water picturing surrounding objects on its bosom, the easy slope of the land, the swan and the spirit of the scene generally which soothes and delights the mind.

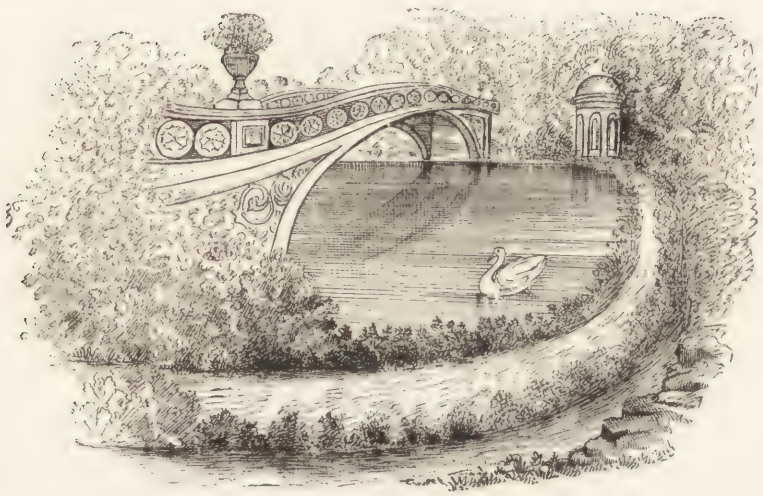


Fig. 65. Gradation, or the Beautiful in Landscape.*



Fig. 66. The sublime in Water.

Figure 66 presents some elements of the beautiful in the curved form and sparkling effect of the waters of Niagara Falls, a part of which appear, but the loftiness, vastness, power, and the terrific contrasts and whirling motions of such mighty currents are especially sublime.

3. *Light and Shadow* appear in countless beautiful and startling manifestations, in the sky especially, as well as on water, and over the mountains and valleys. Gradation of light and color in the sky, represented in fig. 67, is apt to be the most delicate where no clouds are, the light of course being most brilliant where the sun is, and having a progression

* This pretty piece of landscape was drawn for me by a young artist, Miss May Kidder, daughter of Mrs. M. A. Kidder, the well known poetess.

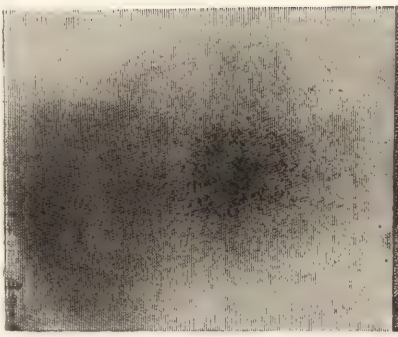


Fig. 67. Gradation in Sky Scenery.

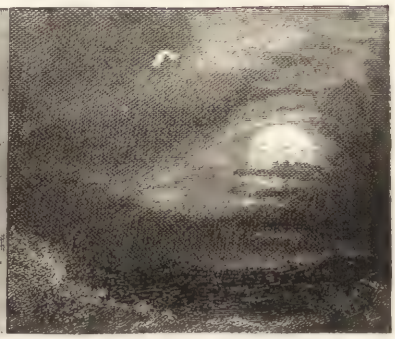


Fig. 68. Contrast in Sky Scenery.

toward shadow as we recede from the sun. In a sunset sky, or a sunrise scene, there are often millions of degrees of tint from the point where the sun is all the way over to the opposite side of the sky, when it is not cloudy ; but in case of clouds, magnificent contrasts of light, shade and color are apt to appear with their more exciting effects. The clouds and light of a tempest often manifest brilliant contrasts, something as in fig. 68. Fig. 69 shows a scene in which contrast and diversity are almost entirely lacking, so that the land can scarcely be distinguished from the water, and the whole effect is feeble. In fig. 70 contrasts of various kinds appear and give a brilliant effect. There is a con-



Fig. 69. A Night Scene.



Fig. 70. Stony Point on the Hudson.

trast of *size* and direction in the rocks and bold scenery as placed side by side with the placid sheet of water ; and there is the contrast of the deep shadow in which these rocks are placed with the brilliant light that flashes over the water, and this light is toned

down by a gradation of shading which gives refinement. The contrast of luminous branches on the shadowy rocks should also be noticed.

4. The *contrast of Masculinity with Femininity is* one of nature's great strokes of harmony, being an admirable method of employing diversity in the sexes to bind them together in unity of spirit. It is really a contrast of gradation of style as predominating in woman with contrast of style as ruling in man. In fig. 71, I have presented the beautiful queen of Delhi, in contrast with the manly head of the Emperor of Germany in fig. 72. The queen's forehead, eyebrows, cheeks, chin, mouth, neck and shoulders are all graceful with gradation; her hair progresses from *lines of beauty* above to *lines of grace* below; her drapery and jewelry are arranged on the flowing and curved style of gradation, while all very strong contrasts both of color or form are avoided. The Emperor with his firm shoulders and neck, his massive forehead and eyebrows, his bold features approaching angularity, his beard and mustache contrasting in form and color with his face, his angular ornaments with their bright colors placed in contrast with the dark color of his coat, give him an appearance of dignity and power. Nothing is more effective in a social circle than a manly man by the side of a womanly woman, the man setting off by his size and ruder power the delicacy and grace of the woman, while the woman enhances the majesty of the man by her more petite and yielding form. The true woman naturally desires in man masculine force of character, and the true man naturally loves in woman feminine refinement and gentleness. By *feminine* I do not mean *effeminate*, and by gentleness I do not mean lacking in firmness of principle. When such natures form a matrimonial union their harmony, both physical and spiritual, will be far greater than two natures which are too much alike, or rather which do not contrast properly. By *contrast* I do not mean *contrariness*, or *opposition*, but distinctly marked diversity in unity; for natures that are almost totally opposite cannot harmonize any better than those which are almost wholly alike.

Fig. 73 presents the face of our eminent ornithologist Audubon, certainly one of the most feminine of masculine faces, from the delicacy of his chin and mouth and the fine curves of



Fig. 71. Zenat Mahal-Begum, Queen of Delhi, drawn by a native artist, on ivory. Illustrating Gradation.



Fig. 72. The Emperor William of Germany. Illustrating Contrast.

his cheeks and eyebrows. His forehead alone seems to have the masculine prominence of outline. To make this femininity the more extreme in style he wears his hair long and laid carefully in curls over his forehead, his collar and drapery flowing and his face wholly without beard, which is certainly a mistaken conception of what is appropriate in manhood. This same mistake is made by many priests, who shave their faces closely and wear those flowing gowns which simply make them resemble women of a large and coarse type. The uncomfortable and heat-producing wigs with long and curled hair which are still worn by barristers in England, are a very unmasculine and very absurd ornament. But the subject of dress will be considered hereafter. The contrasts of the masculine and feminine form are shown in fig. 39.



Fig. 73. Audubon.

5. *Contrasts caused by Reflection.* Nature is not satisfied with filling all things with her fine effects and harmonies which inhere in the objects themselves, but has turned every lake and river and sea into a burnished surface of quicksilver to mirror forth in softer light her real objects, thus making shadows contrast with their substances, as seen in fig. 74, also in fig. 65.



Fig. 74. Contrasts caused by Reflection.

6. *Contrasts in Typography.* I will throw out just a hint as to how different styles of lettering and penmanship may be combined to produce an effective contrast, and also gradation. In fig. 76, the upper and lower words have gradation as their ruling feature, while the middle word has those firm straight lines and sharp angles which make contrast, and so taking them all together is a pretty contrast of gradation and contrast. The grad-

ual swelling and diminishing of the shaded line in the capitals is a gradation of size, while the light and shaded strokes which come near each other form a contrast of size. The word *eminent* has different contrasts, both horizontal and perpendicular, but the shaded ground work of the word should be extended to the other two words or omitted altogether to have perfect unity of effect; but I have chosen them from their applicability in other respects.

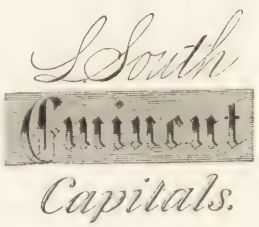


Fig. 75

11. *Contrast in Music.* *Rhythmical* contrast consists of sudden changes from short to long or long to short tones; *dynamical,* in sudden bursts of tone after soft and gentle movements, the use of rests, etc.; *melodic,* in sudden transitions from high to low or low to high notes, and in straightforward and angular movements of the voice rather than in fanciful curvatures and warblings.

12. *Contrast of Ideas and length of clauses* may be seen in the following antitheses of Mirabeau:

"Be firm.....not obstinate;
Courageous.....not turbulent;
Free.....not undisciplined;
Prompt.....not precipitate."

13. A *Gradation of Contrasts in Language* may be seen in the following extract from Chateaubriand, in which each of the three leading steps of gradation from less to more important ideas has a contrast of a smaller with a larger object, as "insect" with "elephant," etc:—

"THERE IS A GOD!

1. The herbs of the valley, the cedars of the mountain, } bless him—
2. The insect sports in his beams, The elephant salutes him with the rising orb of day—
3. The bird sings him in the foliage, the thunder proclaims him in the heavens:—

Man alone has said—There is no God!"

The unity of idea in the above finds its central point in "There is a God," while the diversity consists of the seven clauses which cluster around it, as leaves cluster around a branch.

14. Crystallized or other hard forms usually have that predominance of straight lines and angles which constitutes contrast, and their effect is generally spirited, or if large, sublime, while the more soft or yielding forms of natural growth have usually a predominance of curvature on the graceful law of gradation. For examples of the first see figures 2, 3, 64, etc.; for examples of the second, see vines, leaves, human forms, etc., as in figures 11, 12, 19, 20, 60, etc.

15. *What is the principle of unity in contrasting objects?* my reader may ask. The principle of diversity is evident enough. Take the picture of Stony Point, fig. 70, which presents marked contrasts. Are the rocks so black as to be entirely separated in effect from the white appearing water near it? No, for the water is graded down with shadow so as not to be entirely white, while the rocks are softened down with light to prevent blackness. So far, then, there is unity of effect. But there is also another kind of unity, for the darkness of the rocks works in harmony with the water to develop its brilliancy, while the brilliancy of the water, on the other hand, works harmoniously with the rocks to bring out their bold and massive power the more distinctly. But these contrasts by means of which one object works to glorify its neighbor, are seen all through nature. The red of the flower makes the green of the surrounding foliage seem the more pure by comparison, while the green on the other hand sets off the red and gives it a deeper hue. The foliage harmonizes with the reddish brown of the soil; a violet flower is very apt to be associated with yellow lines or a yellow center, and various other harmonic contrasts exist in different departments of nature, developed on the principle of chemical affinity, which deals in contrasts as will be shown in chapter V.

16. *How is Contrast the type of justice?* A true philosopher will always see an interior spiritual meaning in every manifestation of nature. The earthquake, the tempest and the lightning, which so abound in sublime contrasts, are great purifying and corrective agencies of the physical world. Is not *Justice* the great purifier of the moral world? But as in nature the mountains and cliffs which have been developed by the earthquake are softened down by many yielding and beautiful gradations typical of love, so should human justice be tempered by the gentle hand of mercy.

VIII. Harmony of Analogy.

Analogical harmony requires that there shall be some distinctive expression or special character throughout any work of art or nature in order to the highest perfection.

1. This is really a broad application of the principle of unity, and yet this very law will impart such an individuality to an object, or series of objects, as to enhance the diversity of things as a whole. Nature carries it out in a wonderful way. Thus the sky may be greatly varied with clouds and sunlight, but its analogical principle is the blue color. During a sunset, not only does a golden tint rule near the sun, but it touches the whole sky and landscape into analogical harmony. When the sky becomes overcast with dark clouds, the forest, the water, and the whole landscape partakes of the somberness, as in fig. 76. The artist has given a little piece of the Hudson at West Point by moonlight (fig. 77), and the dimness of the water, of the distant highlands and of the sky itself, shows the analogical principle which is so common in nature. In a romantic or picturesque region, contrast is the presiding genius, and we are apt to find bluffs, cliffs, torrents, and jagged or spiry-topped trees all combined. Fig. 78 shows a small portion of the Au Sable Chasm, in which the spire-like trees surmount the cliffs somewhat as pinnacles surmount a Gothic edifice, and greatly add to the spiritedness



Fig. 76. Shadow.



Fig. 77. Moonlight.

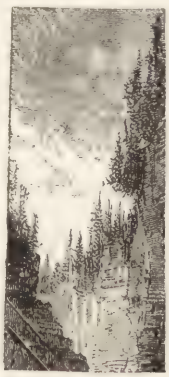


Fig. 78. Part of Au Sable Chasm.



Fig. 79. Portion of Yale College Library.

of the scene. Fig. 79 shows a portion of the Library building of Yale College, which, throwing upward its turrets and pinnacles, as well as its pointed windows and roof, shows how well adapted the Gothic style is to hillsides or other romantic situations, as it would be in harmony with surrounding features. Many architects, recognizing this fact, have placed Gothic churches or other buildings in the same spirited style, on the top of some peak or hillside, and enhanced the effect which nature itself produces. Such an effect is seen on Mont St. Michael, fig. 80. The well known Catskill Mountain House, fig. 81, with its tame horizontal lines, violates in this respect the spirit of the wild grandeur around it, where the very trees and cliffs themselves proclaim a different style.



Fig. 80. Mont St. Michael

2. *Analogical Harmony does not necessarily interfere with diversity* as might be supposed at first thought. Figs. 82 and 83 are portions of New York business buildings. Although the square topped Grecian windows are the simplest of all styles, the architect has found a way (fig. 82) to vary them with their surroundings on different floors without injuring the unity of effect. The same is the case with the Romanesque windows of fig. 83. Fig. 84, which I have



Fig. 81. Catskill Mountain House.



Fig. 82. Grecian Windows.



Fig. 83. Roman Windows.

taken from Ruskin's "Stones of Venice," has an analogical harmony in the great general outline of its beautiful Roman arches, although every arch, as will be seen, has an entirely different style of ornamentation from every other arch, and each pillar differently sculptured capitals, while the space above is filled with constantly diversified figures. Mediocrity clamors for a dead sameness of all windows of a building, or of all ornamental features, or of all pillars, and would balance one tower on one side of a building with another absolutely similar to it on the other side, just as mediocrity in the world of fashion aims at a slavish imitation of some style which is supposed to be *à la mode*, however foolish, unbeautiful, destructive of health, or lacking in adaptation it may be. Genius, however, while carrying out a general analogical spirit, is so rich in resources of creation



Fig. 84. Romanesque Arches from St. Michele of Lucca.

or invention as to develop endless diversity in the midst of his unity, in imitation of nature itself. In fig. 85, we have a specimen of Gothic architecture with its pointed arches, being the doorway of Holyrood Abbey, England, while fig. 86 shows some of the windows in the same structure. It will be seen that the windows in each story are highly different in plan and yet entirely harmonious in effect, not only with themselves but with the doorway, and even the



Fig. 85. A Gothic Doorway.



Fig. 86. Gothic Windows.

doorway itself has various analogical principles in the series of arches and parallel lines with which it is formed, while these very arches have a diversity of ornamentation. Fig. 87 gives a fair specimen of the Elizabethan architecture, which is a mongrel of styles, quite in violation of the analogical harmonies, having no general effect of contrast or gradation ; of straight lines or curves, although it has some picturesqueness of effect. There is the arched doorway and rectangular window, and roof-piece, with no special style at all, projecting quite above the rest of the house, and pretending to be a part of the house, just as the pompous Elizabethan style of dress was full of inflation and vanity, pretending to be more than it was.



Fig. 87. Elizabethan architecture.

3. *In landscape*, a picturesque or romantic location needs more or less of spirited angles in the buildings which may be placed there, as we have just seen, as well as deep contrasts of light and shade in the form of lawns and thick tufts of foliage, decided angles in some of the trees as well as in the walks, and not too much of the polishing effects of art, while in landscapes where the beautiful predominates, winding paths, lawns finished off with smooth surfaces and curved forms, and architecture in which gradation and gentle angles are prevalent, such as Grecian, Italian, the curved Mansard roof or ornamented Gothic, are in place. (See fig. 65.)

4. In *Society*, while both sexes must abound more or less with both gradation and contrast of style in their features, conversation and general character, yet in the true man we expect *power* as the leading trait, however much it may be modified by goodness and refinement, while in the true woman we expect the *gentle and graceful style*, and ability to hold in repose when necessary, any depth of feeling.

5. In *Music*, analogical harmony demands some general keynote or style throughout a part or the whole of a composition.

6. In *Painting*, it demands some general tone of color and leading design throughout the whole piece.

7. In *Logic*, it requires a constant adherence to the point to be proved.

8. In *Versification*, it causes some general style of rhythm

and metre to be adopted throughout a poem, excepting where the principle of adaptation may require a change.

9. In *Colors, any hue harmonizes analogically with a different shade of the same color,* as Chevreul has observed ; for instance, blue will harmonize with light blue, light blue-gray with a darker blue-gray, red with light red, etc. (See Plate II., fig. 2.) This is *analogical contrast.* In the case of ordinary contrast, however, light red does not harmonize well with dark green, nor a deep orange with a pale blue, nor light red-gray with dark green-gray, but the depth of tone in each must be equal to have the best effect of analogical harmony. But chromatic harmony will be explained under its proper head.

10. Thus in all nature and art and society, whatever diversity in the form of contrast or of gradation there may be, the principles of analogical harmony demand that some leading sympathetic thread of unity must bind the whole into one. Liberty and law must be combined. This prepares the way for my next paragraph.

IX. Violent Contrasts are Contrary to the General Laws of Nature.

1. *Harmonic contrast is not antagonism or absolute opposition,* it should be remembered. The contrasts and hues of nature are not violent or pretentious in their general manifestations. The blue of the sky is diluted by the light in the daytime or by shadow at night. The green of the foliage is far better than a luminous color, as it does not dazzle the vision. The sunrise and sunset and the rainbow are all the more beautiful by being temporary, and the awful contrasts of vast overhanging cliffs, great cataracts, tempests and earthquakes, would be unendurable if prevailing everywhere and always. The rocks, the earth, the clouds, the body of plants and trees are generally composed of delicate rich grays or browns which have a modest grace that gives enduring pleasure. Nature has for thousands of years made building materials, such as stones and woods, of these grays and browns ; but man, too slow to take the hint, insists too often in painting his houses in such glaring, positive colors, as white, red, etc.

2. *Exquisite taste* of course avoids what are called *loud colors*, and barbarians have taken charge of most of the flaming red and purple hues for dress, excepting in the case of children, whose sunny nature renders gay colors apropos.

3. In society such rude contrasts as harsh words, violent gestures and screeching tones of passion are relegated to the low and vulgar, although at times great truths and great reforms may be projected upon a careless and ignorant community with a fiery earnestness that may displease for the time being as they tear up old errors, just as the lightning and the earthquake may bring occasional alarm in doing a much needed work of purification.

4. The great leading plan of nature is to combine gentleness and power, or in other words, Gradation and Contrast, sunshine being more potent than the storm, while violence occurs only at rare intervals and even then in order that peace and harmony may the better be brought about.

X. Nature's Unrestricted Growth never Results in Discord or Ugliness.

1. We have seen that nature's progressions when unimpeded are ever toward beauty and perfection of some kind, and yet there are objects of deformity to be seen in the world around us. How is this? These objects do not result from nature's growth, but from the cessation of this growth, as in decay, interference, sickness and death. Plants and animals naturally grow into beauty when unimpeded, but become repulsive in decay, or in disease or imperfect conditions. Figures 88 and 89 are specimens of faces formed by harmonious natural conditions, either pre-natal or post-natal, or both; fig. 90 has had the harmonious growth of nature interfered with by means of the poisonous element of alcohol; fig. 91, by sickness; fig. 92, by a one-sided development of her beastly nature to the neglect of her higher powers; fig. 93, by such a diseased condition of his liver, spleen, stomach, and perhaps kidneys and nervous system, such a pressure and inflowing of forces upon the heart, that he almost dies of hypochondria, or perhaps declares at times that he is actually dead.



Fig. 88. Lavinia, Daughter of Titian.



Fig. 89. Happy Childhood.

2. All *Crystallizations* when formed by natural and slow processes are beautiful; but the violence of volcanoes and earthquakes throws up lava and jagged ore in which unity is quite deficient, and consequently deformity reigns, just as lines of ugliness are painted on the human countenance by the continuous indulgence of violent passions. The barren waste of deserts is also unbeautiful from lack of diversity; but this too comes from impeding nature's processes, as the vapors of the atmosphere which give the rain are obstructed by some intervening mountain ranges.



Fig. 90. The Rum Bloat.



Fig. 91. Insane Invalid.



Fig. 92. The Beast.



Fig. 93. The Hypochondriac.

3. The *Human Form* when developed naturally, without compressions of tight garments, without paints and cosmetics or stimuli, with abundance of pure air, sunlight, natural, simple food, exercise, and a genial noble soul within to illuminate the whole, grows naturally into every style of beautiful outline, color, motion and expression. Pale hollow cheeks with spiritless expression and walk, and fitful nervous action, result from a wrong life in

one's self, or in one's ancestors, or in some adverse conditions of life, all of which are at war with nature's harmonious unfolding.

4. *But decay itself is only a process of a higher development*, a decomposing and recomposing into superior conditions. By means of change and death the earth has progressed up through the geological epochs to the present refinement of things, developing first mollusks, then fishes, then birds and reptiles, then mammalia, and last and highest, man. Judging then by all analogies, even death must be but transition to superior life, and man himself a link in this wonderful chain of upward progression. Is it not an inspiriting thought then that all gradations of color, form, sound and motion, all harmonies of the outward universe, forever exemplify and teach this great principle of progression ?

XI. All Unrestricted Growth of Nature Exemplifies Spiritual and Moral Perfection.

1. *In other words, beautiful growths exemplify beautiful ideas, and all objects are positively deformed which do not do so.* Take the sun for example. The orb itself typifies the parent principle. Its infinitude of rays work harmoniously side by side and typify fraternal harmony. They combine together to glorify the parent orb itself and thus exemplify filial love. This parent sphere gives them life and power and thus exemplifies the love of both the divine and human parent for the children. The light expands toward all the rest of the universe, and thus preaches progression and a sympathy for all. This immense progression at the rate of 186,000 miles a second enhances its luminosity and beauty through attrition on our atmosphere and earth, and thereby shows the glory of action. Thus the sun and stars are ever flashing out upon us their wonderful lessons of individual progression and freedom, and yet fraternal harmony and organization, writing the thoughts of the Infinite over the whole heavens. Suppose that anarchy should reign among the sunbeams and they should war upon each other as do the lines in fig. 34, or sink into the stupid blank of death and inactivity as in fig. 35, the whole matter becomes at once disgusting. Thus we see that *while moral perfection is expressed we have beauty, but so soon as immorality of idea prevails we have deformity.*

2. But again, suppose the leaves of the *Gum Arabic Twig* (Acacia Arabica) should rebel against the fraternal harmony with which nature has endowed them, as seen in fig. 94, and regardless of their neighbors arrange themselves into all conflicting attitudes or sometimes turn themselves into triangles, squares, etc., as in fig. 95, and suppose that the parent stem itself, regardless of its foliage and ignoring all graceful progression of outline should stand forth in a rigid straight line equal in size throughout, would it not be a distressing object to look upon? Truly "righteousness exalteth" a twig as well as a nation. Let us take a leaf, fig. 96, and see what a little bible of divine instruction is written thereon.

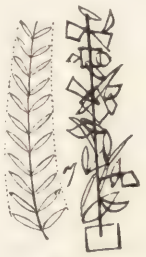


Fig. 94. Fig. 95.



Fig. 96.

Its fibres working harmoniously side by side for the beauty of the whole and never violating their neighbor's rights, teach *fraternal love and justice*, both in the family and in society.

Working in individual freedom, they teach *self-reliance* and *manhood.*

Working in orderly arrangement they advocate *law* and *organization.*

Increasing in size and power as they move toward the central fibre, they preach *progression.*

Spreading out gracefully on both sides, one side a little bolder than the other, they advocate *conjugal love.*

Uniting their life and harmony with the parent stem, they teach us to turn affectionately to our parentage both earthly and heavenly, thus proclaiming *filial love.*

The parent stem sending its life forces to the dependent fibres symbolizes *parental love*, both human and divine.

While it draws its life from the earth, it also opens its tissues and drinks in the sunlight from above, thus teaching us to draw wisdom and power from both the earthly and the heavenly.

Developing in all directions in symmetrical harmony, they teach us to grow broad in our culture and avoid one-sidedness of development.

These are some of the leading instructions and moral bear-

ings of the leaf, including the four great departments of love, which if carried out would convert the terrestrial into the celestial harmony.

3. Again we may take the *Sun* as the parental center of the solar system, around which all its planets, moons, and comets revolve with ceaseless harmony, ever receiving from and giving *to* each other, and we find the same divine lessons taught.

4. Thus does every sun, and planet, and star, and leaf, and flower, and tree, and rainbow, and crystal, and all other unimpeded formations and growths of the whole universe, everlastingly proclaim these divine harmonies. Shall man ever remain blind and deaf and dumb with reference to them?

5. The same beautiful harmonic relations should be exemplified in every family, every society, every community and every nation, with a balance of organization and individuality, and with every part working lovingly with every other part and yet maintaining individual freedom.

6. The foregoing principle constitutes another proof of the absolute unity of all things, the spiritual and the material being irrevocably blended.

XII. The Law of Perfection.

Those objects present the highest perfection, other things being equal, which embody the greatest number of Harmonic Principles.

1. *Niagara Falls.* This cataract is the admiration of the world. Why? It presents beautiful gradations of direction in the parabolic curves of water as it sweeps over the rocks; gradation of velocity from top to bottom, and gradation in the curves and hues of the rainbow which gilds the clouds of spray. It presents Contrasts of direction in the mad dash and whirl of waters, contrasts of rocks and water, contrasts of water in the sunlight and water in shadow, contrasts of white foam with the dark blue sheet before it becomes foam, contrasts of size in the great cliffs and water above with the depths below. The whole presents the analogical principle of continuous sublimity—sublimity in the great rocks, the mighty currents, and a power

which utters itself in thunder and shakes the earth. We see, then, every style of external harmony combined.

2. *The Human Head*, being the culmination of the highest features of man, who is himself the culmination of nature, presents the most wonderful combination of harmonic features. It has contrasts of size and direction in the upper and lower head, in the front and back head, in the hair and face, in the nose and cheeks, or forehead and cheeks, or chin and cheeks : it presents contrasts of color in the hair and face, or beard and face, in the pupil and white of the eye, etc. : it presents gradations of direction in the exquisite curves everywhere present, as in the chin, lips, cheeks, eyes, eyebrows, nose, forehead, hair and whole head ; and gradations of color in the cheeks progressing from the lily of the side cheeks to the rose in the center ; and more or less of the same in the lips, eyes and hair : it presents analogical harmony of color in the face, eyes and hair, as when the hair is dark, the eyes and skin are apt to be dark also ; and analogical harmony of form, as when one feature is bold and contrasting, others are apt to be the same. More than this, the head is the center of the most marvelous possibilities of thought and deed, the brain being the head-quarters of those mental, passional and intuitional energies which change the face of the world and develop all harmonies ; the vision being the mirror on which all harmonies of the outward world are painted, the vocal apparatus being the instrument for producing all harmonies of tone and sound, and the ear the instrument for taking cognizance of these harmonies. More than all this, there is a fine spiritual something that emanates from a peculiarly fine and animated face which causes us to speak of it almost unconsciously as *sparkling* or *radiant*. The human head is the greatest center of perfections, then, because it embraces the greatest variety of harmonies.

3. *A Beautiful Human Form* starts with the smallest number of harmonies in infancy, and increases in its variety of perfections until fully matured. The young babe (fig. 59) presents but little excepting gradation, and this in the form of rather stiff curves. Emma (fig. 57), who is a little older, shows a greater distinctness of chin and diversity of curves, Katie (fig. 58) shows still greater diversity of curves, and shows not only

freer gradations than the others, but a fair amount of contrast, as the hair contrasts in form and color with the face, and the features are more prominent. In figures 60, 62, and 71, we have the mature form, and find not only more distinct contrasts, but more exquisite gradations of both form and color, and these harmonies extend to the bust and other parts of the system as well as to the head. Let the reader notice that there is a great contrast in the size of the gradations in mature forms, but very little in quite young children, especially the curve of the cheek as compared with that of the chin, or the convex curve of the cheek as compared with the concave curve uniting the cheek and chin. In figures 57, 59, 89, and the small forms on the outer portions of fig. 61, this concave curve will be seen to be nearly as large as the convex curve forming the cheek itself, but notice the great change as the forms become more mature.

4. *Forms, Motions, etc.* We see, then, that however beautiful or effective an object may become through gradation or contrast alone, it attains to a still higher perfection when it combines both without violating analogical harmony, and a still higher perfection when it combines the harmonies of form, color, motion, etc., than when it combines only one department of harmony. A rocket shot upward in the daytime is an uninteresting object compared with what it is at night, for in the daytime it makes a feeble gradation of form, of velocity, and of sound, while in a silent dark night these gradations are far more distinct, and the contrast of brilliant lights and colors with the surrounding shadows, as well as of motions and sounds when the explosion takes place, gives it a tenfold charm.

5. *Landscape.* The finest contrasts and gradations can be included in a single landscape, but analogical harmony requires that the two styles be not too much combined in the same place, as the *graceful style* in which curved walks and sweep of surface and round-topped trees abound, should not pass too abruptly into the *picturesque style*, in which cliffs, cascades, spiry-topped and jagged trees and similar contrasting features abound. A view, however, combining both styles of landscape is peculiarly charming This may be illustrated by a sail down the Hudson, on the right side of which are mountains and Palisades, illustrating the picturesque and sublime, while on the left side are more

sloping banks, with mansions, lawns and parks, in harmony with the beautiful.

6. *Light, Shade, and Color.* We have already seen how poor the effect in a cut like fig. 40, where contrast exists without gradation as compared with figures 38, 41, 70, etc., in which contrast and gradation are both combined. In a sunset sky we may see gorgeous contrasts of light and shade and color on the clouds, also exquisite gradations of the same progressing toward shadow from west to east, and analogical harmony ruling throughout. Is it not far superior to the shadowy sky of a thunder-storm, in which contrast alone rules?

7. *The Aurora Borealis,* or *Northern Lights,* combine a great



Fig. 96. The Aurora Borealis.

variety of harmonic principles (fig. 96), such as a general archway, or gradation of direction, gradation of light and shade, gradation of velocities in the shooting lights, contrasts of light and shade, contrasts of direction, of color and of size, while a general law of analogy blends the whole in one. We may see just the reasons, then, for its being considered one of the most beautiful sights in nature.

8. *Architecture.* It may rivet these great principles upon the reader's mind by showing how they may be applied to regulate architecture, an art of which even architects too often fail to understand the spirit. Figures 97, 98, 99, 100, present the leading

roofs of the world. The Oriental is the simplest and will answer for rainless climates; the Grecian, being an obtuse angle, has a little more decision and strength, and will shed rain, but is not so adapted to snow; the Gothic, being an acute angle, is the strongest and most spirited of all, and is adapted to snowy



Fig. 97. Grecian Roof. Fig. 98. Gothic Roof. Fig. 99. Chinese Roof. Fig. 100. Oriental Roof.

regions, while the Chinese is the most graceful, but is weak. The dotted lines on the outside of fig. 98 show the modification of the Gothic, called the French or Mansard roof, and is especially well adapted to residences. The dotted lines in fig. 99 show a more graceful modification of the same, having both gradation and contrast, while the other has contrast mainly. Fig. 101, shows a cottage in this style, which I have copied from Godey's Lady's Book. It is graceful and spirited. The dotted lines in the center of fig. 98 show how a spire is only a steeper Gothic roof. In the mere outlines of roofs, the Grecian has but a feeble contrast of direction and no gradation, the Gothic a spirited contrast, the Chinese both contrast and gradation, while the Oriental has a death-like unity, wholly lacking in diversity. The simplest form of a Greek building with its low roof and rectangular windows (fig. 82), has contrasts but no gradation. This, of course, was too unbeautiful for the finer buildings, and so pillars, with their flutings and volutes and leaf-work added gradation, as did also the statuary and other sculptured forms which were placed under the roof. In the common Greek edifice contrast rules, and that of rather feeble character, although when modified, as in fig. 102, gradation and contrast are combined, with gradation and grace as the analogical feature.



Fig. 101. Cottage with Mansard Roof.

But the Greek style, although capable of much elegance in its simplicity by means of pillars and sculpture, is on the whole a feeble style, with its main lines horizontal and earthly, and poorly suited for religious or state edifices where majesty of spirit is required. The Gothic, on the contrary, with its magnificent contrasts of spires, turrets, pinnacles, buttresses, pointed arches and massive towers, all heaven-pointing, softened down and refined by the most exquisite gradations of every kind, is the sublimest, strongest, most spirited and most expressive style of architecture that has thus far been devised by man. Its pinnacles, with their bud-like finials, denote upward growth; its windows have leaf-like arches, unequaled for strength; its vaulted ceilings, sustained by pillars which branch off like trees, are built seemingly for eternity, while in every direction the curved flower and leaf-work proclaim nature as the divine model which it aims to copy. Fig. 103 gives a portion of a fine Gothic edifice which is a celebrated seat of learning. It shows a variety of contrasts of height, of direction, of size, of light and shadow, as well as various gradations of size and direction, and an admirable analogical harmony in the midst of its great diversity. The spirit of the Gothic style is to "beautify utility," as Pugin expresses it; for when it ornaments such features as pointed arches, buttresses, and even towers and pinnacles, it deals with that which is eminently strength-giving, whereas when the Grecian style



Fig. 102. A Greek Portico.



Fig. 103. Eton Hall, England.

rears its immense columns and lofty porticos, it works for mere display, for these columns are useless in protecting either from the storm or from too great heat of the sun. The Gothic Architecture is sometimes called *Christian*, from its heaven-pointing style, but as other religions also aspire after divinity and heaven, they have an equal right to it, especially as the Mohammedans are known to have used the pointed arch and upward aspiring minarets in A.D. 780, or something like four centuries before the Gothic was adopted by Christians. Figures 104 and 105



Fig. 104. Fig. 105.
Ruins near the Taj Mahal, Agra.

represent old Mohammedan ruins in Asia, in which the pointed and upright features appear in many of the windows as well as minarets, domes, etc. This style is sometimes called Arabic, Moorish, or Oriental, and finds its analogical feature in curvature and grace rather than in the contrasts and power characteristic of the Gothic. The most gorgeous specimen of architecture in the world is to be seen in the wonderful palace of the old Moorish Monarchs in Spain, called the Alhambra. Although both the Moorish and Gothic architecture combine all principles of harmony, yet the greater strength and spiritedness of the Gothic must give it the verdict of superiority.

In figures 106–110, I have given a glimpse of some notable domes and towers. Domes, towers, spires, turrets, pinnacles, and minarets are among the leading methods of producing the effect of loftiness, grandeur and spiritedness in a building, and sometimes, as when there are Gothic or Roman arches with keystones, their weight gives stability to the walls and firmness to the arches. The United States Capitol, at Washington, has

a dome which ranks among the great ones of the world, but depends upon gradation almost wholly for its effect. The Hotel des Invalides, Paris (fig. 107), adds to its gradations those angular and projecting forms which give contrast, while the new Connecticut State House dome, at Hartford (Fig. 108), becomes still more spirited in its fine contrasts and still more elegant in in its gradations of size and direction than either of the others. It has a form which is a transition from the dome to the tower. Fig. 109, is the central tower of the magnificent New York State capitol at Albany, and although an elaborate piece of architecture, it is built in the renaissance style and hardly knows whether to assume the spirited combinations of the Gothic or the tamer grace of the Roman arch system, or the pediments and horizon-



Fig. 106. Dome of Capitol at Washington. Fig. 107. Dome of Hotel des Invalides, Paris. Fig. 108. Conn. State House. Fig. 109. Central Tower of the N. Y. State House. Fig. 110. Tower of Memorial Hall, Harvard University.

tal lines of the Greek architecture, and thus must be pronounced deficient in individuality and analogical harmony. Not so with the Gothic tower of the Memorial Hall of Harvard University (Fig. 110), which is one of the finest styles of architecture in the country, spirited in its angles, colors and forms and yet refined in its gradations. It borrows some of its refinement from the Mansard Gothic. Fig. 111, from the same building, has much of the effectiveness of a spire and yet simplicity of style and a certain analogical harmony with the roof, of which it seems to be an outgrowth. Fig. 112 is one of the spirited and elegant side towers of the Connecticut State House. Figures 113, 114, are graceful and effective portions of the gateway of Greenwood Cemetery, Brooklyn, the latter of which shows how a gable can grow into a spire-like form and how the rudeness of a sharp

angle can be softened by curvature. Fig. 115 is a ventilator, and gives more variety of effect to the top of a building. Fig. 116 is the top of Bunker Hill Monument, a great rude, meaningless heap of stones, devoid of beauty, or soul, or harmonic principles—simply one of the "bignesses," as Isaac Newton would say, quite unworthy of the cultured taste of Boston. "But this elaborate work, this beauty, costs money which should be taken to feed and clothe the poor," is the common remark. To these superficial utilitarians to whom the bread-and-butter side of life is the chief object of existence, I would like to make a remark as we pass. Suppose that in the place of this rude mass, an object of beauty and inspiration had been reared, that scenes expressing high aspiration and self-sacrifice and grand achievement had been sculptured on its sides in a way to last a thousand years, so that millions of people should cast their admiring gaze upon it



Fig. 111. Fig. 112. Fig. 113. Fig. 114. Fig. 115. Fig. 116. Fig. 117. Fig. 118. Fig. 119. Fig. 120. Fig. 121. Fig. 122.

and drink in its lessons, would it not tend to lift multitudes above the gross appetites and sensualities of life to such an extent that it would save them from a large amount of poverty and degradation? Fig. 117, the Washington Monument, is better, but is far from what it should be. Fig. 118 is the tower of the University of Toronto, and although the body of the tower is not very spirited, the round pointed turret at the corner adds greatly to its effect and forms a contrast with it. Fig. 119 is the picturesque tower of the Masonic Temple in Philadelphia, which, though possessing some very pretty lines of gradation, has contrast and power as its leading spirit. Fig. 120 is a castellated tower, and stands rather low on the harmonic scale, as it is totally lacking in gradation and is consequently rude. Fig. 121 is a portion of the cottage residence of Thomas W. Ludlow, Esq., near Yonkers, and will show how chimneys and bay-windows, and roofs and verge-boards, and wings may serve to destroy the box-like character of a

house and give pleasing contrasts of light, shade, size and direction. Fig. 122 shows the form of buttresses which give so much strength and picturesqueness to the walls of a Gothic building. Fig. 123 is the Oriental or Moorish horse-shoe arch, which although having a variety of contrasts in the way of straight lines and angles, has gradation as its leading spirit. Fig. 124 has also gradation as its predominating influence, although the acute angle at the top gives a spirited contrast. These ogee curves are simply *lines of beauty*, and although they form a most elegant arch, still they are less strong than that of the ordinary Gothic window. It is much used also in Oriental architecture. Figures 125 and 126 have both styles of harmony, but contrast and power seem to be their leading analogical spirit instead of gradation, as in the other two. Fig. 127, which I have



Fig. 123.
Moorish Arch.

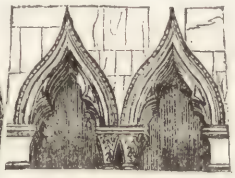


Fig. 124.
Ogee Gothic Arch.



Fig. 125.
Perpendicular Gothic.

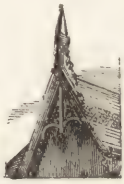


Fig. 126.
Gothic Gable.

taken from Harper's Monthly, is entitled a "Newport Cottage." It is full of the spirited lines of contrast and yet has some very graceful gradations, especially in the little spire at the left, and the curved line under the roof. The little spires give a brisk and aspiring effect to the building without resembling a church spire, and the many angles cause a diversity of light and shade which form a general unity of spirit in contrast.

XIII. Adaptation or Fitness.

1. *Adaptation of means to ends is a law of universal nature.* We have seen that the unimpeded growth of nature is always according to harmonic principles, but there are times when great utilities demand the temporary suspension of these and the use for the time being of seeming or even real discords. The earthquake is very terrific and temporarily disastrous, but it brings

about the equilibrium of the earth's internal forces, brings the interior riches of the mineral kingdom to the surface, and gives to man the charms of mountain and valley where otherwise would be a dead level.

2. In the process of Human Development also nature has rendered *labor, effort* and *conflict* an absolute necessity by leaving more or less of swamps and forests to be reclaimed, homes to be built, fields to be tilled and boundless realms of knowledge to be sought out, without which man would become utterly weak and worthless from inaction, and really be far more miserable.

3. *Suffering* has also its divine mission, 1st, as a result of violated law and a warning against such violation ; 2dly, it gives dis-



Fig. 127. A Newport Cottage.

cipline, heroism and self-command when rightly improved ; 3dly, it is nature's process of purification as in the case of *disease;* 4thly, it calls out human love for the unfortunate, the divinest of qualities, and 5thly, it answers as a shadow to reveal by contrast the real sunshine of life ; in other words, when perchance through severe experiences, blunders and struggles we have attained to the knowledge and wisdom which will do away with the necessity of so much suffering, our real joy and power will be greater than it otherwise would have been. It is the duty of the community, however, to elevate society by correct knowledge

and equitable laws into so true and wise a life that they shall not need so much severe suffering to make them live rightly, while they will find their happiness in performing voluntary labor, instead of their misery in doing that which is forced upon them.

4. Thus we see that *Absolute Evil* does not exist, the universe being under the reign of divine law, while all seeming evils are but adaptations to some high end. Are fire and water innately bad because they sometimes destroy life? Is society fundamentally bad because much selfishness and crime occur in its midst? Is man necessarily evil because like an unripe apple he may as yet be in his crude, sour state? Have we not seen that all natural growth is on the law of perfection, all things bearing the stamp of divinity? Let us not indulge in the superficiality of pessimism then, but remember that harmony itself sometimes becomes more effective by the temporary suspension of harmony, especially when some good end is sought. The great masters in music sometimes introduce discord to heighten some after effect, and at times discordant or rude combination of colors are allowed by the greatest artists for the purpose of expression. "Great art," says Ruskin, "dwells on all that is beautiful; but false art omits or changes all that is ugly. Great art accepts nature as she is; but directs the eyes and thoughts to what is most perfect in her; false art saves itself the trouble of direction by removing or altering whatever it thinks objectionable. Beauty deprived of its proper foils and adjuncts, ceases to be enjoyed as beauty, just as light deprived of all shadow ceases to be enjoyed as light. A white canvass cannot produce an effect of sunshine; the painter must darken it in some places before he can make it look luminous in others; nor can an uninterrupted succession of beauty produce the true effect of beauty; it must be foiled by inferiority before its own power can be developed. Nature has for the most part mingled her inferior and nobler elements as she mingles sunshine with shade, giving due use and influence to both, and the painter who chooses to remove the shadow, perishes in the burning desert he has created." *

5. *Nature does not employ beauty so incessantly as to destroy adaptation and utility.* A clear sun is beautiful, and yet if we had not the soft shadows of night and occasional clouds and storms,

* Modern Painters, by John Ruskin, M.A., Vol. III. p. 34.

the earth would soon become parched and destroyed. But even in the storm, spirited elements of harmony and sublimity are brought into action.

6. In the *Human Form*, curvature is especially harmonious and consistent with its yielding nature. A circular building, however, is not pleasing for a residence, first, because it lacks in fitness for the utilites of home life ; and secondly, straight lines and angles, softened down perhaps with ornamental lines of curvature, harmonize well with the natural *decision* of the building materials themselves. Some have been so foolish as to suggest that buildings should resemble the human form.

7. The ouside of a building should be more sober in its tints than the inside ; first, because a white or nearly white building dazzles and burns the person approaching ; 2dly, the subdued light of the interior can better tolerate light-colored walls ; and 3dly, artificial light becomes more brilliant when the walls are not sombre.

8. *Brilliant Colors* are more admissible in theatres than in churches, and yet the cultivated human mind requires that gaudiness shall not rule in the former nor gloom in the latter. To those who look upon the severe side of God's character and consider that a majority of the human race are in danger of everlasting destruction, life and death become awfully solemn, and only dimly lighted cathedrals, with silent tread of worshipers and the predominance of dark grays and browns would be considered in correct taste.

9. In *Dress*, health requires that one's clothing should not be uniformly black, and analogical harmony requires that an elderly lady should dress in more subdued colors than a young girl. As to the sexes, woman, belonging to the graceful side of nature, in which gradation rules, sees intuitively that delicately tinted and yielding skirts, hanging in curves around her, are far more appropriate than the stiff bifurcated garments of men ; while men, decided and strong in their style, dress more on the plan of contrast, parting their hair on one side, training their beards, which contrast with the color of the face, and having mainly the simple contrast of black and white around the neck and bosom. Woman loves to wear and man loves to see her wear, more ringlets, curls or flowing forms of the hair, and more ornamental forms and

colors than is generally, becoming to the other sex. But taste and utility demand that her skirts shall be long enough to be flowing and protective to her limbs, and yet not long enough to become darkened with dust or interfere with a graceful gait, while health imperatively demands that all compression of the waist or feet, all large foreign masses of hair to heat the brain, and all abdominal pressure of skirts should be forever banished. Does not beauty of form and grace of motion demand the same things?

XIV. Truth.

Truth and conformity to law are universal in nature.

1. *Nature* is ever true to herself and all her great principles of harmony and adaptation. Were her laws of repulsion and attraction to be changed for one moment, the whole universe would become a mass of ruins. *Nature does not pretend to be what she is not*, and holds up her swamps and deserts as freely to the sunlight as she does her sublimest landscapes. The lightning does not pretend to have the gracefulness of the rainbow, nor the rainbow the power of the lightning, nor the little stream the majesty of the great river, and yet all perform their especial work with unchanging faithfulness.

2. Light is the greatest truth-teller in the outward universe, flashing forth by means of its reflections the forms and colors of all nature, and by aid of the spectroscope giving a minute analysis of all elements. "God is truth and light is his shadow," was the well-known expression of Plato. Even in the case of a *mirage*, where distant objects are seen double, there is nothing but the strictest truth to nature's forces, the wonderful diversity of which simply causes a reflection in unexpected places.

3. "There is never vulgarity in a *whole* truth," says Ruskin. The whole atmosphere and sky and ocean are transparent media for conveying truth. Human eyes are mirrors to receive all truths of form and color, human ears sounding-boards for receiving the truths of tone, and the organs of smell, taste and sensation are constituted to perceive other styles of truth. It is of supreme importance that we should perceive and proclaim

exact truth. "One of the sublimest things in the whole world," says Bulwer, "is plain truth." Every author's pen, every artist's pencil, every orator's tongue, every power of genius and statesmanship should work in harmony with all truth, which is the only pathway of safety, while error is not only the pathway of danger but of deformity.

4. *Human Nature* naturally scorns falsehood in principle, and yet prejudice, early training, psychological bias received from surrounding influences, theological ruts, medical ruts, political ruts, social ruts, all worn so deep by long use that small men getting into them cannot see out, or get out, have tended to lead into darkness and mar the heavenly image of truth. Why is man thus behind external nature in his development? Because he is the last and highest phase of nature and has not yet reached his true moral and spiritual era of unfoldment. It may require a century to build a great cathedral, while a cottage could be finished in a month; in the same way it may require a thousand centuries to perfect the mental and moral structure of man, which is so vast in its possibilities as to take hold almost upon infinity, while the processes of evolution could develop the simpler external phases of nature in a vastly shorter time, just as it took millions of years to develop a mammal after a mollusk had been perfected.

XV. Refinement of Material.

Other things being equal, substances are exquisite, penetrating, powerful, and enduring in their effect in proportion as they are refined and subtile.

1. *Nature* is full of proofs of this law; but I must treat it only briefly here. The grossest form of water is *Ice*. A more refined form is *ordinary Water*, and this, when put in motion, can sweep away houses, forests and rocks. A still more refined form is *steam*, which is about 1700 times as light as water, and its tremendous power in driving the most ponderous machinery is well known. A grade of power vastly finer than steam is *Electricity*, and this, uniting with steam far down in the bowels of the earth, will at times blow the mountains asunder and cause half a continent to tremble. Having reached electricity, we have found a

principle so fine that it can penetrate more or less well all tangible substances.

2. Of the exquisiteness and amazing power of *Light*, demonstrations will be given hereafter.

3. Finer than any of these is the *Attraction of Gravitation*, which, according to the demonstration of La Place, moves millions of times as swiftly as light, and yet is so mighty as to float all worlds on its breath and so exquisitely gentle as to yield to a mote in the sunbeam.

4. The explanation of those wonderful *Soul-emanations* which are the quickening power of mentality and by means of which man is enabled to move outward and measure and weigh suns and systems and to look inward upon a still mightier psychic world, I must reserve for the tenth chapter of this work and for a future work. A single example may be given here to illustrate this law.

5. The coarsest grade of heat is the form of *Ordinary Fire*, or heated metals. A person may warm himself by this, and he will often feel weak and tender afterward by the means. If he warm himself by heat from the sun, which is a grade finer, he finds it less weakening and more enduring. If he warm himself by exercise or by manipulation from some warm magnetic hand, not only are the lower animal but the higher psychic forces put more or less into action, and he may become permanently warmer and stronger. Thus are the fine forces more *safe, powerful, exquisite* and *enduring* than the coarser forces of the outward world, such as ordinary heat, mineral drugs, etc. Their effect on *mental action* is also much more direct and potent. The great healing power of colors will be treated of in the chapter on Chromo-Therapeutics. This principle is modified somewhat by the next.

XVI. Gradation of Instrumentalities.

Force is exerted through a gradation of instrumentalities, the general law of positive power being that a coarse element is acted on or quickened by one which is finer, this again by one which is still finer, and so on.

1. Thus in the human system the bones are wielded by the muscles, which are a grade more subtile; the muscles by the nerves and blood, which are still finer; the nerves and blood are vitalized and controlled by still finer animal and psychic forces, and these again by spirit, which is inconceivably fine.

2. The fine forces constitute *positive* principles of power, while the coarser forces are the negative and reactive principles. It is impossible for one grade of force to control directly another which is too much below it in fineness or in turn be controlled by it, any more than meal could be retained by a coal-sieve. Grosser elements may have a reflex influence upon the finer, somewhat as the body may re-act upon the mind by having its cruder elements influence those less crude, and these again, those which are still less crude until the mind itself is affected. This is a great negative law of power, and we must not fall into a very common error that all power lies with spirit, regardless of coarser re-active elements.

3. Some of the *Leading Gradations in Nature* are given in Fig. 128, commencing at the outside and progressing in fineness inward until we reach Spirit, which is the positive principle of all power. The finer forces radiate their power through the whole circle of elements and forces, each force passing more or less through those which are coarser than itself, but more immediately as a general thing, through the next grade of coarseness, while this again permeates that which is still coarser and so on. Thus *Spirit* gives life to the very finest ethers or *Spiritual Forces;* these vitalize still coarser ethers, such perhaps as *Electricity*, *Light*, etc.; these latter kindle up the *gases* and the *liquids*, while they again permeate and perhaps dissolve the *Solids*. Thus nature ever works on the law of Gradation, even sometimes when it does not seem to do so.

4. The *Foregoing Principles* include the outlines of the science

of harmony and power in nature; also the central law, which shows that unity and diversity must be combined, and that on the law of progression, or contrast, or both. I have given them so that if possible we may at last get down to the basic principles of things in connection with light and color. Nature is a divine guide if we apprehend its teachings rightly, but it is sad to see how it is misunderstood. Prof. Taylor Lewis * says that

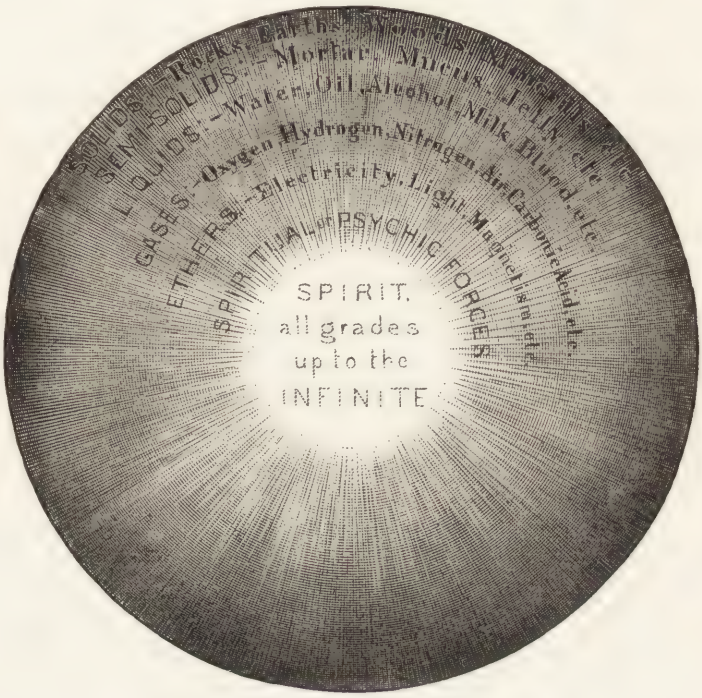


Fig. 128. Gradation of Elements and Forces.

"if we obey nature it follows that an act of *self-sacrifice* would be as foolish as it is sinful and unnatural. It would be a violation of nature's grand law." Is not this a slander upon nature? My readers have seen how *all natural growth over the whole world exemplifies paternal love, filial love and fraternal love. More than that, the course of nature is an endless series of sacrifices of lower conditions for the sake of introducing higher ones, of lower animal and vegetable life that a higher grade of existence might*

* Since writing the above, this able writer has deceased.

take place, and sometimes of cities, islands and seas by an earthquake in order that terrestial harmony may be established. The greatest universal sacrifice is that of human life for the higher life to come.

Having established the general principles of harmony, I will now notice their more direct application to colors.

XVII. Division of Colors.

1. *Historical Note.* In 1672, *Isaac Newton* published his theory that the ordinary white light of the sun consists of different colors possessing different degrees of refrangibility. Still earlier, however, in 1611, Antonio De Dominis had used the following words:—"Colors arise out of light: of this I have no doubt; nay, they are only light itself." * Isaac Newton adopted the seven-fold division of colors as seen in the rainbow and still more distinctly in the solar spectrum, namely the *red, orange, yellow, green, blue, indigo* and *violet.* Sir David Brewster considered the *red, yellow* and *blue* as the three fundamental colors out of which all other colors are made; but Helmholz has shown that each color of the spectrum is formed by its own independent law of vibrations, which is incapable of subdivision, and that there is no overlapping of certain colors to make an intermediate color, as red and yellow to produce orange, yellow and blue to produce green, etc.

2. When the reader comes to see how colors are produced, he will understand that there are not only seven colors in the sunlight which are uncombined with others, but many times seven. Fig. 129 will show how light is brought into a dark room by a very narrow opening and by means of a prism scattered into its separate parts, or colors which fall upon a screen in an oblong rainbow-colored form called the solar spectrum, the red being refracted least and the violet most from a straight line. Suppose we make an opening in the screen at the point where the orange strikes it and then pass this orange ray through another prism behind the screen, will it be decomposed into the two colors yellow and red? No; it will remain exactly as it was before, thus showing that it is a primitive and indivisible ray. This is not

* *De Radiis Visus et Lucis*, 1611.

saying that orange cannot be made by means of red and yellow pigments, but that it is not so constituted in the sunlight.

3. *Sound and Color compared:* There is no harm in dividing the colors into seven divisions on the Newtonian plan. In fact it is rather a good division and harmonizes with the seven notes of the musical scale, C, D, E, F, G, A, B; C answering to red, D to orange, etc. As C is at the bottom of the musical scale and made with the coarsest waves of air, so is red at the bottom of the Chromatic scale and made with the coarsest waves of luminous ether. As the musical note B requires 45 vibrations of air every time the note C at the lower end of the scale requires 24, or but little

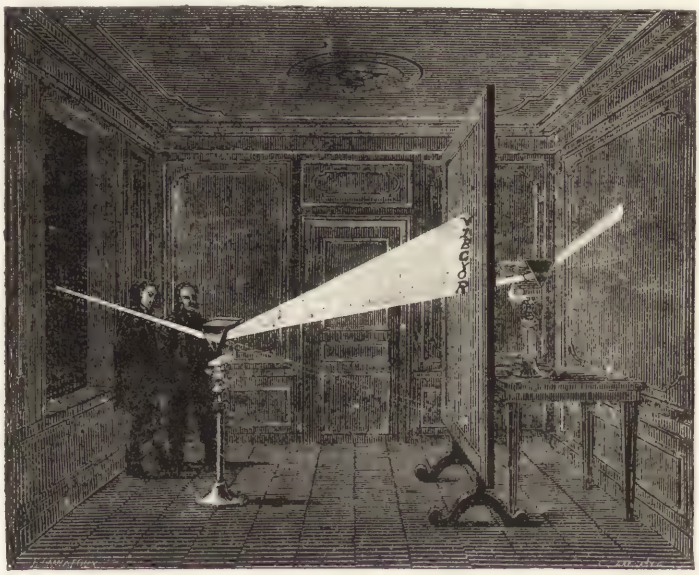


Fig. 129. Decomposition of Light by the Prism.

over half as many, so does extreme violet require about 800 trillions * of vibrations of ether in a second, while extreme red requires only about 450 trillions, which also are but little more than half as many. When one musical octave is finished an-

* In speaking of numbers I adopt the French method of enumeration of three figures to a period, usually adopted in America, instead of the more cumbrous English method of six figures to a period, so that when I say 800 trillions I mean 800,000,000,000,000. What we would call *one billion* the English would designate by the more complicated expression *one thousand millions*, etc.

other one commences and progresses with just twice as many vibrations as were used in the first octave, and so the same notes are repeated on a finer scale. In the same way when the scale of colors visible to the ordinary eye is completed in the violet, another octave of finer invisible colors, with just twice as many vibrations, will commence and progress on precisely the same law, as will be demonstrated in the chapter on Chromo-Chemistry. The shortest atmospheric waves that ordinary ears can take cognizance of before the tones become too shrill to be perceived, are about three and a third inches in length, while the shortest violet waves, the effect of which can be perceived by ordinary external vision, are 100,000 times as short, as it requires 60,000 vibrations, or in other words, 30,000 complete waves of such color to make one inch in length. The longest waves of air which can be perceived as sound by human ears are about 70 feet in length, which constitues the lowest bass notes, while the longest complete waves of ether which can be received into human eyes as color, would require some 17,000 to 18,000 to an inch, or not far from fifteen million times as many as the largest waves of sound require. Does this prove that the eye is capable of receiving impulses of force millions of times as exquisite as those received by the ear? By no means, as a far more refined force than mere waves of air must necessarily work in connection with them. (See Chap. Eighth, VII., 4). Will it be answered that light moves 186,000 miles a second while sound moves through the air at the rate of only 1,100 feet a second? But the fine principle of sound can be made to move as swiftly as light by aid of a proper conductor, as shown by the telephone, which has lately been made to carry the human voice on wings of electricity entirely unaided by any magnet or electrical machine. A seeming advantage in favor of sound is that ordinary human ears can distinguish from nine to eleven octaves of musical tones while ordinary vision cannot perceive quite one octave of colors, in fact can take in only the seven Newtonian notes, or a septave. This would seem to show that human evolution has not yet reached so far into the refined elements of vision as it has into the coarser ones of sound, all development reaching coarser elements before they attain to the finer. While the seven color arrangement is convenient for some purposes, we may also have a still more funda-

mental classification of only three colors to match the three fundamental notes in the musical scale, the *first, third* and *fifth.* Some trinal divisions of colors will simplify matters to the reader's mind and will now be given, although as will be seen hereafter a division of fourteen primary color rays would seem to conform to the law of chemical and molecular forces.

XVIII.—Triad of Primary Colors.

A few words may be appropriate as to the threefold division of representative *Colors.* We have.

Red, an exciting color at nearly the centre of heat.

Yellow, the medium color and centre of luminosity.

Blue, a fine color which is cold, soothing, electrical.

Practically all colors can be made out of these or could be if we could get a supply of the invisible red to assist in forming violet and indigo and could find pigments of absolutely pure red, yellow and blue. We have also

XIX.—A Triad of Secondary Colors.

Orange composed of equal parts of red and yellow.
Green " " blue and yellow.
Purple " " blue and red.

XX.—A Triad of Achromatic or Neutral Colors. Pl. II, 4.

Black composed of equal parts of red, yellow and blue.

White composed of five parts of red, three parts of yellow, and eight parts of blue.

Gray (*normal gray*), composed of black and white

This is given from the formula of eminent artists and would seem to prove that after all "black is white, and white is black," but not quite. It cannot be verified entirely in practice from the impurity of pigments. When we call them *neutral* we mean neutral, chromatically speaking, as they have no especial hues, but white is the most positive of all colors as to luminosity. The folly of calling black the absence of colors is now done away with among the intelligent, although it is really caused by the absorption of all colors. Normal gray is the most neutral of all colors and does not make discord with any.

XXI.—A Triad of Primary Grays.

Red Gray, or Russet, composed of normal gray and red.
Yellow Gray, or Citrine, of normal gray and yellow.
Blue Gray, or Olive, of normal gray and blue.

XXII.—A Triad of Secondary Grays.

Orange Gray, composed of normal gray and orange.
Green Gray, " " " green.
Purple Gray, " " " purple.
Orange Gray and *Red Gray* are sometimes called brown.

XXIII.—Trinal Division of Tints and Shades.

1st. *Light tints of a color* in which some white is introduced, as light yellow, light blue, light green, light gray, light green-gray, light blue-gray, etc.

2d. *Medium grades of color*, such as ordinary yellow, purple, red-gray, green-gray, etc.

3d. *Dark Shades of Color*, in which some black is introduced, as dark yellow, dark blue, dark green, dark red, dark gray, dark red-gray, etc. These are said to have a lower tone.

XXIV.—Trinal Division of Hues.

The three basic colors, red, yellow and blue, should have a definite meaning and for this reason it is not so correct to say green-blue, orange-red or green-yellow, as it is to say blue-green, red-orange, yellow-green, for the great central colors are not to bend to the secondaries but the secondaries to them. From the imperfection of language, however, we sometimes are forced to say reddish-blue, yellowish-blue, bluish-red, etc., and by these terms we mean blue with a very slight tint of red, blue with a slight tint of yellow, red with a slight tint of blue, etc. A general threefold division of the secondaries may be made as follows:

Orange, combination of red and yellow.

Red-Orange, red and yellow combined, with red in excess.

Yellow-Orange, red and yellow combined, with yellow in excess.

GREEN, combination of yellow and blue.
YELLOW-GREEN, yellow and blue, with yellow in excess.
BLUE-GREEN, yellow and blue, with blue in excess.
PURPLE, combination of red and blue.
BLUE-PURPLE, red and blue, with blue in excess.
RED-PURPLE, red and blue, with red in excess.

For further study of the colors see plate II., 1, in which the part of purple nearest the blue is blue-purple, that nearest the red is red-purple, that between these points near the periphery is deep medium purple, that near the centre, light purple, and so with the other hues, which may also be represented in fig. 3 of same plate. As I have said violet cannot be exactly represented by any two pigments combined, but I have had a blue-purple placed on the plate as the nearest representation of the violet.

XXV.—NOMENCLATURE OF COLORS.

1. We have thus a very simple and yet comprehensive nomenclature of colors by means of which we may use precision of expression on this subject, a thing in which scientists themselves are somewhat deficient. For instance if we take different color combinations in which *red* is used, we have such terms as reddish black, dark red-gray, red-gray (russet), light red-gray, red, light red, very light red or pink, reddish white, red-orange, red-purple, reddish-blue, reddish-yellow, red with a very slight tint of blue, as in *carmine* or crimson, light red-orange, dark red orange, orange, yellow-orange, light orange, dark orange, orange gray, light orange-gray, dark orange-gray, purple, light purple, dark purple, purple-gray, light purple-gray, dark purple-gray, etc. These are some of the terms which include more or less of red, and the other colors can be varied on the same principle.

2. The *chromatic* hues consist of the primary and secondary colors, and also appear more dimly in the primary and secondary grays, etc. The *achromatic* or neutral colors include the black, gray and white. Some choose to give the combination of two secondaries the name of *tertiaries;* thus, for instance, green and purple are said to form the tertiary *olive* or *blue gray*. But

the other method which I have adopted is much simpler, and amounts to the same thing, thus :—

$$\left.\begin{array}{l}\text{Purple} = \left\{\begin{array}{l}\text{Blue,}\\ \text{Red,}\end{array}\right.\\ \text{Green} = \left\{\begin{array}{l}\text{Yellow,}\\ \text{Blue.}\end{array}\right.\end{array}\right\} = \text{Gray.}\Bigg\} = \text{Blue-Gray.}$$

In other words, purple and green include the three primaries and blue besides, and as the three primaries when combined in a certain way make gray, it would have been much simpler to have said in the first place that blue-gray is formed by combining blue and gray, as signified by the name itself. In the same way green and orange form yellow-gray ; orange and purple, red-gray.

XXVI.—Triad of Colors, Tones and Forms.

Before proceeding to illustrate harmony of colors, let us pause a moment to notice a threefold arrangement also in sounds and forms. The delightful tri-chord in music, called the *triad*, consists really of the leading fundamental sounds, by modifying which all music is formed. This, however, is well understood and I will dwell briefly on the triad of leading forms, the *triangle*, the *hexagon*, and the *circle*. The *triangle*, like the red color to which it answers, is bold and stimulating and the coarsest of forms, as that is the coarsest of colors. The circle, answering to the blue color, and the type of all curvature, is soothing and fine in its degrees, while the hexagon, like the yellow color, is the medium between extremes. The triangle abounds in spirited, hard, crystallic substance, such as the diamond, zinc-blende, magnetic iron ore, fluor-spar, topaz, arragonite, and various octohedrons and rhomboidal forms. The hexagon is doubtless the most admirable of all angular forms, combining spiritedness of angles with regularity of contour, a character which is lacking in triangles and octagons. Hence it is a favorite form in nature, being found in honeycombs, crystal of quartz, ice, calcareous spar, beryl, apatite, snow-crystals, which are either hexagonal or at least arranged in six divisions, cellular tissues in many vegetable and some animal growths, etc. The circle and the blue color, which it matches, are found beautifully combined in the sky

which is nature's representative dome, and the infinitude of starry worlds, including our sun, which beautify its expanse, are also mainly on the plan of the sphere which includes an infinity of circles. As the triangles and other angular forms of which it is the type belong more to hardness, spiritedness and power, so does the circle and other curved forms of which it is the type deal with softness, gentleness and grace, as with the sky, the human form and all worlds, which last were soft when they assumed their spherical shape. In this it is matched by the blue color again, which stands at the refined end of the scale, and prevails in the soft depths of the sky, the ocean and the whole world of foliage, atlhough the foliage combines yellow with the blue, and presents an infinitude of curvature. The violet would naturally be represented by the oval, which is more exquisite than the circle, and this oval must approach more and more nearly to points, one at the small end and two at the large end, in proportion, as it becomes extreme and draws near to the red of a higher scale of colors.

XXVII.—Harmony of Gradation in Colors.

1. Having now seen the parallelism and the unity which exist through the great departments of nature, and some of the beautiful progressions and contrasts by means of which this unity is enriched by diversity, let us now apply these principles more directly to light and color. First, then, we will look at *gradation*, or the law of gentle progression.

2. The achromatic gradation between black and white constitutes different degrees of normal gray as in fig. 130.

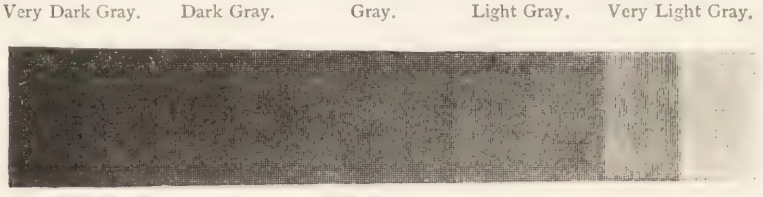


Fig. 130. Gradation of Normal Gray.

3. A *Gradation of Chromatic Grays* may be seen beautifully developed in plate I. Fig. 1 in the centre is white; 2 is a light normal gray; 3 is the circle of light chromatic grays, such as

light yellow-gray, light yellow-green-gray, light green-gray, light blue-green gray, light blue-gray, light blue-purple or violet-gray, light purple-gray, light red-purple gray, light red-gray, light red-orange gray, light orange-gray, and light yellow-orange gray, which completes the circle; 4 is the circle of medium grays, as yellow-gray, yellow-green gray, green gray, etc., around the circle as before; 5 is the circle of dark grays, such as dark yellow-gray, dark yellow green gray, dark green gray, etc. The dark orange and red gray are often called *browns*. These grays form exquisite colors for buildings, for ladies dresses, etc.

4. By looking at the inner circular portion of Plate II., gradation of *form* in the shape of the circle will be seen, within which gradation of *hues* extending around the circle is given, as also gradation of *tints* in which the colors fade away into the light as they move inward towards the star. Let us notice these gradations more minutely.

1st, we have *Gradation of* DIRECTION in the circle.

2d, *Gradation of* HUES in the following order: *red, red-orange, orange, yellow-orange, yellow, yellow-green, green, blue-green, blue, blue-purple, purple, red-purple.*

3d, *Gradation of* TINTS and SHADES as *deep red, medium red, light red or pink, deep orange, orange, light orange, deep yellow, yellow, light yellow,* etc.

XXVIII.—GRADATION OF COLOR IN THE SPECTRUM.

1. When the sunlight passes through a slit leading into a darkened room, and then through a triangular piece of glass called a prism, as in fig. 129, the rays of light are separated by refraction into their constituent colors on the same plan as in the rainbow, and fall in an oblong figure upon the opposite wall. This oblong combination of colors is called the *Solar Spectrum* (see Plate I.), and being nature's direct arrangement should be well studied in this and suceeding chapters, as laws of vast importance will be found in connection therewith. Both the red end and the violet end of the spectrum fade off into black, at which point the chromatic hues cease, although the real sun power extends far beyond the visible portion at each end, as will be seen hereafter. The following diagram will give a rude idea

of the colors of the spectrum, the classification to the left of which will be thoroughly demonstrated in the chapter on Chromo Chemistry, and that at the right, in the chapter on Chromo Therapeutics.

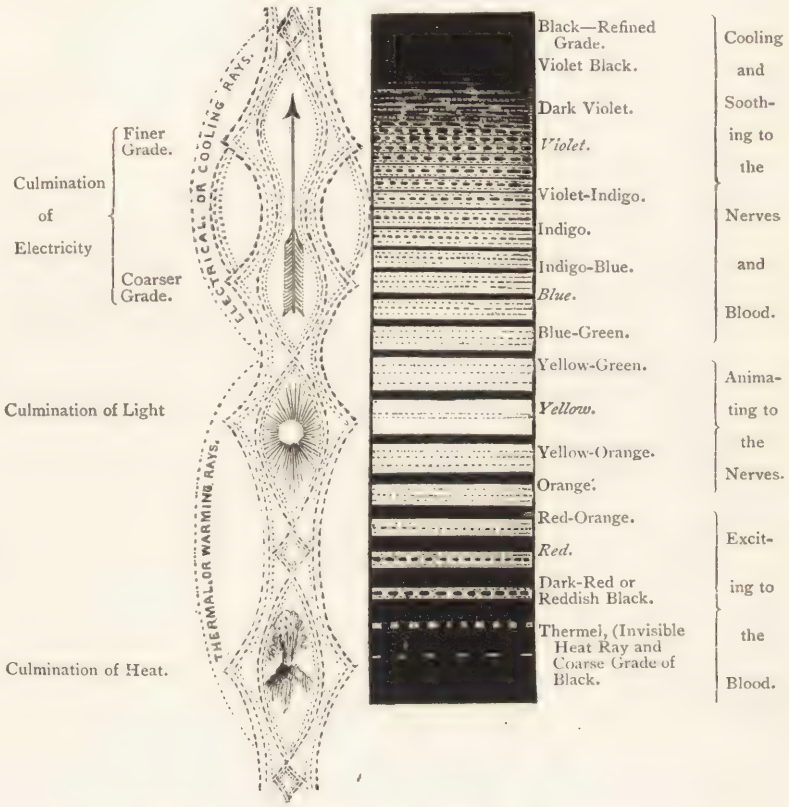


Fig. 131. The Solar Spectrum Analyzed and Systematized.

2. Where I have it *Culmination of Electricity*, the old method was to denominate it *Actinism* or *chemical force*, but Prof. Draper and other scientists have shown that this is a misnomer, as chemical power, only of another kind, dwells as much at the red end of the spectrum as at the violet end. In the chapter on Chromo Chemistry this matter will become doubly clear. An array of facts in chapter third will be adduced to show that the colors of the finer end of the spectrum are electrical and magnetic in their nature, while those of the coarser end, reaching to

yellow-green inclusive, are thermal, or heating in their nature. The rays just below the red in the invisible portion, which are the hottest of all, I have termed *thermel* from the Greek (*θέρμη*) *therme, heat.* For full descriptions of it, see Chapter Fifth, XXIII., 5, 6, 9, etc.

3. From the lower to the upper black the progression is toward superior coolness and fineness of vibratory action, and power to soothe the nerves.

4. From the upper to the lower black, the progression is towards superior warmth, coarseness and animation.

5. From both ends to the yellow, the progression is towards luminosity; from the yellow downward it is toward the coarse grade of shadow; from the yellow upward, toward the fine grade of shadow.

6. There is a trinal series of gradations in the *peculiar potencies* of colors, the centre and climax of *electrical action which cools and soothes the nerves* being in the *violet,* the climax of *electrical action which is soothing to the vascular system* being in the *blue,* the climax of *luminosity* being in the *yellow,* and the climax of *thermism* or *heat* in the red, and especially in the *thermel* just below the red. This is not an imaginary division of qualities, but a real one, the flame-like red color having a principle of warmth in itself, the blue and violet, a principle of cold and electricity. Thus we have many styles of chromatic gradation including progression of hues, of lights and shades, of fineness and coarseness, of electrical power, luminous power, thermal power, etc. In Plate II., 3, the colors are ranged in a circle opposite those with which they form a chemical affinity, as the blue opposite the red, etc.

7. The following gives some *leading Gradations* of two colors from light to shadow.

Bluish White, (as in zinc).	Yellowish White (magnesia).
Very light blue.	Very light yellow.
Very light blue-gray.	Very light yellow-gray.
Light blue.	Light yellow.
Light blue-gray.	Light yellow-gray.
Blue.	Yellow.
Dark blue.	Dark yellow.
Dark blue-gray.	Dark yellow-gray.
Bluish-black, or blue-black.	Yellowish black.

8. These, of course, may be varied in different ways. The other colors may be carried through the same gradations. In fact, nature's gradations are infinitely diversified. There are gradations of contrasts, and contrasts of gradations, and gradations of gradations without end in colors, forms, motions and sounds. The gradation of colors in the solar spectrum and the foregoing names are a somewhat more direct following out of nature than those of the colored circular plate.

XXIX. Harmony of Contrast in Colors.

See Plate II., Fig 1.

1. *Chevreul* of France first discovered and developed as a science the harmony of contrast in colors, and his theory so improved the effectiveness of the fabrics of France as to make their superiority over those of other nations quite apparent, especially at the World's Fair held in London in 1851, and set the people to studying his works which simply exhibited what nature had been exemplifying and trying to teach through all the ages. In fact it will be shown in another part of this work, just how, by means of chemical affinity, all contrasting substances and forces naturally tend toward each other and develop each other.

2. But how shall we ascertain the real harmonic contrasts of any color? By simply getting its *complement.* Thus if we take the *triad* of colors as our scale, we have *red,* for instance, forming a contrast with the combined result of the other two colors, yellow and blue, which is *green, yellow* forming a contrast with red + blue = purple, and blue with yellow + red = orange. We may on this principle then construct

3. A Table of Harmonic Contrasts.

Red and Green	contrast	harmoniously.
Yellow and Purple	"	"
Blue and Orange	"	"
Red-gray and Green-gray	"	"
Yellow-gray and Purple-gray	"	"
Blue-gray and Orange-gray	"	"
Red-purple and Yellow-green	"	"
Red-orange and Blue-green	"	"
Yellow-orange and Blue-purple	"	"

LIGHT RED-GRAY and LIGHT GREEN-GRAY contrast harmoniously.

DARK RED-GRAY and DARK GREEN-GRAY " "

DEEP-BLUE and DEEP-ORANGE " "

4. The *leading contrasts* of color are presented on the title page in connection with the contrast of form in the hexagon. The tendency of a color to intensify its contrasting hue near it, may be seen by looking at the six small circles within the hexagon. The gray on the inside of all of these is precisely the same, and yet the red ring gives its interior a *greenish* cast, the green *ring brings* out the red slightly, the purple a yellowish tint, the yellow a purple tint, etc.

5. A little *more exact arrangement* of contrasting hues is arrived at in connection with the seven colors of the spectrum, which is nearly as follows :

RED contrasts with green with a slight violet cast.

ORANGE contrasts with indigo or indigo-blue.

YELLOW contrasts with violet or bluish purple.

GREEN contrasts with red with slight violet.

BLUE contrasts with red-orange.

INDIGO contrasts with orange.

VIOLET contrasts with yellow.

6. It is not to be considered that the colors will be absolutely discordant if many variations from the above plan are adopted, as blue contrasts very well with light red or yellow, etc. Any two contiguous colors of the chromatic scale are always discordant, just as are any two consecutive notes of the musical scale. Thus red makes discord with orange, orange with yellow, green with blue, etc., except when they blend by a gradation.

7. The *neutral* colors, black, gray, white, are not positively discordant with any, and yet they have their effect. Chevreul admits that *black* lowers the tone of all colors, *white* hightens the tone or depth of all, and gray makes them seem more brilliant by contrast. He considers that white combines best with light blue, then with light red, and badly with orange; while black combines best with red or rose, then with orange, then with yellow, and poorly with light green.

XXX. Harmonic Colors in Architecture.

1. There is such a great pressure of important matter that should be set forth with reference to the harmony and philosophy of colors that my applications of the subject to human art must necessarily be brief.

2. Nature's contrasts do not consist of *antagonism* or *contrariness*, on the *contraria contrariibus* law, but of spirited diversity on the law of unity. How would a white house look with the cornices and trimmings painted jet black? I speak of this work of man because, in nature, I can find no such abominations to quote from, or at least none excepting in cases of ruin or convulsion which temporarily suspends regular processes. Although we may rarely ever see a person so rude in harmonic perception as to have his residence thus bordered with black, like a blot on the fair face of things, yet many there are who will have the body of their houses almost white and the trimmings so dark that they seem to be dressed in mourning.

3 But suppose we have a house painted in its main body with a light yellow-gray, which is nearly cream-colored, and trimmed around the windows, piazzas and cornices with a darker yellow-gray, sufficiently contrasted to be very distinct without violence, we have then a harmonic contrast, the principle of unity being the yellow-gray which binds both colors in a brotherhood while the principle of diversity is the difference of light and shade between the two.

4. Another style of harmonic contrast would be to trim the same yellow-gray house with a purple-gray of equal depth of shade, as in Plate II., 5. In this case the principle of unity consists in their both being of the same tone of gray, and the same depth of hue, while the diversity consists in difference of effect between the yellow and purple, each of which brings out the purity of the other by contrast.

5. Again we may have a graceful *Progression of Contrasts* by having light yellow-gray for the body, medium yellow-gray for the inner lines of the cornices and dark yellow-gray for the outer lines.

6. Soft hues of red gray for a house are exceedingly tasty, as they constitute a pleasing contrast with the green of the foli-

age, and so are the different tints of the green-gray, if the green is not made too prominent, from its analogical harmony with the foliage.

7. One great charm of a country home is to have soft but effective contrasts of color as well as those contrasts of light, shade, and forms exhibited in verandahs, bay-windows, towers, projecting roofs, angles, etc. In architecture a *contrast of contrasts and gradations* is often very effectively exhibited in the bold angles, and straight lines, softened down by curved ornaments, especially in the Gothic style, and also in the Norman arch whose curves are rendered spirited by introducing straight lines and angles within the arch itself. To render the effect complete there should be a contrast of colors also.

8. *Tasty Residences are painted with the trimmings and bolder lines darker than the body of the house.* This gives a look of strength, and seems to be most in harmony with nature's great dome-work of the sky in which the sun fills the middle portion with light, and shades it off at the horizon with more sober hues. Of course we cannot paint a hundredth part as beautifully as nature does, but we can follow her general principles afar off. The contrasts of different colors of stone to form the arches of windows and doors are very pleasing, if not made too distinct and if in harmony with the rest of the building.

9. *Within the House* the hues can be made more of delicate contrasts, and more or less of gradation of shading and tinting can be used. What the wealthy should aim at in their residences, is to have the walls shaded off and varied with a soft and cheerful ground work of color, in the midst of which skilled artists should paint their scenes, not of bloodshed and horror as on the walls of the Palace of Versailles, but of landscape, of important historical events and of that which appeals to the true and the beautiful. Thus the storm may rage without, and the great bustling world may have its corrupting influences, but within the sacred precincts of home, forever photographing their spirit upon the souls of the family and visiting friends, are the bloom and verdure of nature, or some scene of grace and merriment, or a radiant and pleasing group of human forms engaged in some high purpose. These, of course, should not be brought out with glaring colors, but modestly and yet richly, so that more and more

they will grow upon the preception as they are viewed from time to time.

XXXI. Colors in Dress.

1. I have already mentioned some of the adaptations of color in male and female dress. The kind of adaptation which constitutes analogical harmony in the dress of a lady of blue eyes, fair complexion and auburn hair, would be well carried out by a light blue dress trimmed wlth a deeper or darker blue, and combined with white collars, etc., or the whole dress may be trimmed with white. Or if such person is not too aged, a white dress for warm weather would be in good taste. The blue forms a harmonic contrast to the auburn hair. But where the red is too prominent, blue should not be used. Some carry the analogical unity so far as to have jewels, gloves, and shoes of the same general color as the dress. The blue dress presents a contrasting harmony with auburn or light colored hair.

2. *Blondes* look well in light-colored dresses, *brunettes* in darker ones, while rubicund countenances can wear to advantage subdued tints of red, as in red-gray, etc.

3. If a countenance is too pale, a greenish element will enhance the rosy color by contrast, while a purple tint near the face will bring out the yellow and give a bilious, sickly appearance, which no one can well afford.

4. If a person's countenance is overflushed and rosy, a condition which is rarely seen among our American ladies, a red ribbon worn near the face will give a paler cast.

5. Contrasts of the positive colors, such as red and green, blue and orange, yellow and purple, are too glaring to be in good taste except for military or theatrical costumes, and for the young. The grays of these same colors are much more tasty and modest.

6. Too much of the dark elements in the colors of clothing degrades the light into heat, and prevents its finest chemical action on the human system. The relation of color to health, however, will be explained in the chapter on *Chromo Therapeutics*, XXX.

7. Some people, including half-civilized nations and children, are charmed with flashing colors, and dazzling contrasts in their

clothing, just as others must have violent contrasts of voice and gesture in oratory before they will admit there is any eloquence. This comes from an undeveloped and stupid condition of the finer perception, so stupid in fact that they must have blows that will almost overwhelm a sensitive person, before they can feel them. It is in harmony with a brilliant climate like that of America, however, that the people should adopt somewhat gayer colors than would be most suitable in England. While our ladies as a whole possess exquisite taste in dress scarcely equaled in Paris, some of them have still certain faults, such as being a little too gaudy and going to the extreme of fashion, although these extremes may at times be devoid of taste, common sense, healthfulness or adaptation to their form or complexion. While our men can bow to fashion so much as to wear overcoats which dangle around their heels, making them resemble somewhat a rudely dressed woman, or a little boy in his father's coat, our ladies wear skirts that drag in the mud, so that walking becomes a constant burden from the weight of drapery that they must ever be lugging around in their hands.

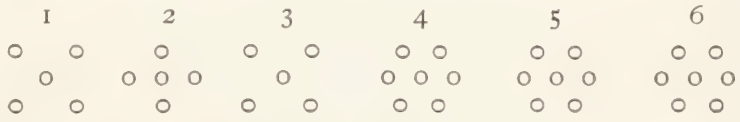
8. The *Straining after Effect, and violation of truth* by the use of paints, enamels, bleaching and dyeing processes, are resented by nature, for just as soon as the pores of the skin become habitually clogged with these paints and enamels, and poisonous dyeing materials are resorted to, real *dying* begins to take place, the blood moves less briskly, the skin grows more lifeless, the eyes grow less sparkling, and the movements less elastic. Walking and exercising in the open air, sunlight, bathing, manipulation of the whole body, and simple nourishing food, will gradually and surely bring nature's imperial stamp of beauty and power, and prevent all need of these falsehoods and deceptions in the way of ornamentation.

XXXII. Colors in Floriculture.

1. While at the Gardens of Versailles near Paris in 1868, I was struck with the beautiful effect of contrasting lines of flowers, as well as the exquisite gradations and angles and curves in the flower beds themselves. Sometimes a bed would be bordered with long lines of purple or violet flowers running parallel to another line of yellow flowers of about the same size, sometimes

clusters of flowers of one color would contrast with clusters of another color, sometimes masses of red leaves and flowers will be encircled with contrasting masses of green foliage, etc. All tasty parks and landscape-gardens now in our country and Europe pay much attention to the harmonies of color.

2. For valuable hints with reference to the arrangement and grouping of flowers, the colors of drapery, etc., I would refer the reader to Chevreul's "Harmony and Contrasts of Colors." I will condense some of his ideas about the grouping of dahlias, etc. The three first groups below consist of five dahlias each and constitute *quincunxes:* the other groups have seven dahlias :—



These may be grouped as follows :—

1. Four Orange Dahlias with Purple Dahlia in centre.
2. Four Purple Dahlias with Yellow Dahlia in centre.
3. Four Yellow Dahlias with Purple Dahlia in centre.
4. Six Scarlet red Dahlias with White Dahlia in centre.
5. Six White Dahlias with Scarlet red Dahlia in centre,
6. Six Pink Dahlias with White Dahlia in centre.

3. The following *is a linear arrangement*, with blue as its centre of unity in the middle plant :—

1. Red Chrysanthemum.
2. Yellow Chrysanthemum.
3. White Chrysanthemum.
4. Orange Chrysanthemum.
5. Large Blue Aster.
6. Orange Chrysanthemum.
7. White Chrysanthemum.
8. Yellow Chrysanthemum.
9. Red Chrysanthemum.

4. The following is another linear arrangement of Primroses.

1. Red Primrose
2. White Primrose.
3. Orange Primrose.
4. Lilac Primrose.
5. Yellow Primrose.
6. Violet Brown Primrose.
7. White Primrose.
1. Red Primrose, and so on, repeating as above.

One leading law of unity in the above groups consists in having the same style of plant, while the diversity consists in the contrasts of colors. Gradations of color, as well as in the forms of grouping might be suggested, but space is lacking.

XXXIII. Synopsis of Harmonic Laws.

In reviewing our ground we find the following great laws drawn from the divine teachings of nature, and constituting a basis upon which all edifices of science and philosophy must be built if they are to assume eternal foundations:

1. *The principle of Unity universal in nature, exemplifies the divine Oneness and Attraction as well as the divine Fatherhood, also human Fatherhood and the law of Organization which is the unifying principle of all families, societies and nations.*

2. *This Unity is projected into boundless* Diversity, *thus exemplifying the divine Repulsion and Infinity of Resources and proclaiming the law of Individual Life and Freedom.*

3. *Nature's great* Law of Harmony *is the equilibrium of the principles of Unity and Diversity, exemplifying the universal rule of Liberty combined with Law, of Centrifugal balanced by Centripetal Force, of Individual Effort working with Fraternal Organization, of Repulsion and Attraction vitalizing and perfecting each other, of Impulse and passional Propulsion harmonized by the divine law of Right and self-control.*

4. Gradation *or regulated* Progression *is one of the great leading methods in which nature manifests this Unity and Diversity. Its course is ever toward some principle of excellence, being manifested through all the details of the universe and carrying the whole upward toward superior conditions, and never downward toward inferiority, ruin or death excepting temporarily and for the sake of a higher perfection to come. It is a prominent law of beauty by means of which lights, shades and hues progress into each other and blend; forms move by infinite steps in curvature, musical tones and oratory pass into graceful sweeps and climaxes, while in society, this same principle softens down the angles and blunt points of life.*

5. Contrast *is the bold and spirited method by which nature manifests her Unity and Diversity, combining tints, shades and colors in masses, forms in angular projections, and all things in decided transitions. It is the masculine side of nature, and presents that display of power which we term Sublime, just as Gradation is the Feminine or graceful side, belonging to the beautiful.*

6. Analogical Harmony *is seen in nature in the form of some*

ruling characteristic throughout her leading departments, as, for instance, the blue color which predominates in the sky. In art on the same plan a leading tone of color is adopted throughout a painting, a certain Key-note for a musical composition, etc.

7. VIOLENCE *and* FLAMING CONTRAST *are exceptional manifestations of nature, allowed only rarely and briefly for some important end.*

8. *Nature's unrestricted growth is never discordant.*

9. *All Beauty and all Natural Growth exemplify Moral and Spiritual Perfection. All objects which do not do so are deformed.* The person who takes cognizance of suns, stars, leaves, flowers, trees, landscapes and sounds as merely an assemblage of forms, colors, and tones devoid of this diviner expression, is blind and deaf to the principal meaning of the universe, and can never attain to the conception of High Art. *Let those who decry real Beauty then remember that they are condemning the expression of the Infinite Goodness.*

10. *Adaptation, which rules throughout nature, suspends temporarily at times the direct expression of Beauty and goodness for the purpose of introducing some higher Good.*

11. *Truth is the voice of all nature,* and so-called works of art which pervert it must prove failures.

12. *Elements are generally penetrating, exquisite, safe and powerful in their effect on man in proportion as they are refined and subtile.*

13. *Force is exerted through a gradation of Instrumentalities.*

14. *Colors, like Musical Tones, are divided into seven distinct notes, and still more fundamentally into three, constituting the Triad of the first, third and fifth. Forms also present their parallelism.*

15. In order the better to understand the great laws of things, I will here present more fully than in the preceding pages some of the leading twofold and threefold divisions of mind and matter.

DUAL DIVISIONS OF THE UNIVERSE.

Diversity	Unity.
Contrast	Gradation.
Spirit	Matter.

Light, ...	Shadow.
Repulsion, ...	Attraction.
Positive Forces, ...	Negative Forces.
Centrifugal Force, ...	Centripetal Force.
Tints of Color, ...	Shades of Color.
Chromatic Colors, ...	Achromatic Colors.
Masculinity, ...	Femininity.
Straight Lines, ...	Curves.
Magnetism, ...	Diamagnetism.
Heat, ...	Cold.
Alkalies, ...	Acids.
Electro-Positives, ...	Electro-Negatives.
Organs of the Right side, . .	Organs of the Left side.
Warm or Thermal Colors, .	Cold, Electrical Colors.
Luminous Orbs or Suns, . .	Non-luminous Orbs or Planets.

TRINAL DIVISIONS OF THE UNIVERSE.

Triad of Primary Colors : .	Red, yellow, blue.
Triad of Secondary Colors : .	Orange, green, purple.
Triad of Achromatic Colors :	Black, gray, white.
Triad of Primary Grays : .	Red-gray, yellow-gray, blue-gray.
Triad of Secondary Grays : .	Orange-gray, purple-gray, green-gray.
Triad of Chromatic Forces : .	Heat, light, electricity.
Triad of Achromatic Qualities :	Tints, hues, shades.
Triad of Outlines :	Straight lines, angles, curves.
Triad of Forms :	Triangle, hexagon, circle.
Triad of Musical Notes : . .	First, third, fifth.
General Divisions of the visible World :	Solids, liquids, gases ; also Land, water, sky.

16. In the foregoing the Dual divisions are *contrasts* and the Trinal divisions, *gradations*. Thus we see that nature, though at first thought it seems to be lawless in its wonderful freedom, is after all governed by the most absolute law, all her great machinery working with mathematical precision, her fountains, cataracts, etc., describing parabolic curves, her worlds moving in elliptical spirals through the heavens and around some centre of unity, while the force of *Gravitation*, *Light*, etc., is

inversely as the square of the distance from the influencing orb. We may fire a cannon ball into the air in any possible direction, or at any rate of speed, and not for a moment can we make it vary from the most absolute gradation of motion, while if sent in any but a vertical pathway, it will describe also a perfect gradation of *Direction*, following nature's favorite and beautiful curve of the parabola. The rainbow rears its semi-circle and assigns just such a relative width to each color throughout, each tree approximates the form of an ellipse, or oval, or spire, or many sections of an oval, while every leaf and blade of grass and flower is carved out and posed on the most exquisite principles, in general after some one or more *sections of a cone.*

17. *Harmony of colors is now a science.* It should no longer be said that this and that combination of colors is *a mere matter of taste.* Of course *taste* must have something to do with it, as the principles of harmony may not always be correctly applied without it, but certain rules can be laid down which place many points beyond guess work or caprice of taste. Ladies of refined taste have in general a perception of colors and their harmonious relations quite superior to that possessed by gentlemen, partly from having more practice with colors, and partly from possessing a finer intuitional nature. In fact some of our sex will need all the rules and all the science they can command on the subject, to enable them to equal in chromatic taste many ladies who have had no rules excepting what their finer perceptions have given them.

CHAPTER SECOND.

INSUFFICIENCY OF THE PRESENT THEORIES OF LIGHT AND FORCE.

I.—Science and Philosophy should be Combined.

1. Scientists are spanning more and more of the universe and weighing and measuring all things in their scales. Their acumen in many fields of investigation has been so marvelous that all men have had to bow to their authority. From their laborious researches in many directions I have received great instruction and shall ever be grateful for the immense assistance which I have derived from them in the various fields of human thought.

2. While I would look with this admiration upon their efforts and with all humility upon my own powers as being quite incompetent to tread in many fields which they have graced, still it seems to me that they have failed to reach fundamental principles. Not for a moment would I do so base a thing as to disparage others in order to establish any theory of my own, for Truth, supreme Truth is the great central light, and let no man dare to hide or falsely color a single one of its radiant lines. It seems to me that they have not sufficiently combined philosophy with their science, so that their facts might be crystallized into great truths by comprehensive generalizations, but have dwelt too much upon external specialties, as Agassiz himself once admitted.

3. Ancient sages scorned as vulgar the *Inductive Process of Reasoning* which brought them down to every day facts and generally adopted the *Deductive Method.* Since Lord Bacon's teachings have been given to the world men have swung to the other extreme of induction. It seems not to have occurred to many people that induction and deduction should never be divorced—that we should look upward to causes and downward to effects with the same glance as far as possible using the intuitional and

reasoning nature to *grasp* the invisible "*soul of things*," which constitutes the positive principle of power, and the perceptives to grasp the outward *body of things* which constitutes the negative principle.

4. While delving so much in the cruder elements of matter, the interior lightning which gives it potentiality eludes the grasp of many of our scientific men. Although all force in its primary principle thus lies with the fine invisible elements, they too often flee from these with seeming alarm, and cling to the mere skeleton of power which dwells with the gross and the tangible.

II.—Basic Principles not yet Reached. Cohesion.

Is my judgment harsh? *Have they arrived at the fundamental laws of any style of power whatever?* Take a silver dollar, for instance, and ask them what makes its atoms cling together with such tremendous tenacity. A weight of ten thousand pounds would not press or pull them apart. Do they say *cohesion?* But that is only a word. What causes the cohesion? We are as badly off as ever. If we understood the nature of cohesion, we should begin to understand something of chemistry. If a substance decays it falls to pieces. Where is cohesion now?

III.—Chemical Affinity.

If a piece of zinc is put into sulphuric acid the water is set to boiling, countless bubbles rise, and the metal is soon torn tc pieces. How is this done? Chemical affinity is the answer. But what is the law of chemical power by which such things are done? Here again the scientific world comes to a dead halt. "Chemical force, like other force cannot be described," says Dr. Attfield, "for like them it is known only by its effects." "Chemical affinity, like all great forces in nature," says T. P. Barkas F. G. S., "is perfectly incomprehensible." "Notwithstanding our boasted advances in science," says Prof. Robert Hunt, "we have scarcely arrived at any satisfactory knowledge of the powers which regulate the internal conditions of matter. The molecular forces are almost entirely beyond our conceptions."

IV.—Electricity.

1. Being badly at sea then with reference to chemical forces, how is science with reference to the great power of Electricity? Scientists are still quite undecided as to whether electricity is a single fluid on the theory of Franklin, or two fluids on the theory of Dufay, or no fluid at all but simply a vibration of polarized atoms. If the atoms are polarized, what polarized them?

2. How are the vibrations started and continued? Just how does friction excite electricity? Does the instrument that frictionizes take hold of the fluid and move it along?

3. What is the law of movement with electricity, over the surface of atoms, through their axial portion or how?

4. How is *Induction* produced, and how *Conduction*, and *Attraction*, and *Repulsion*, and *Magnetism* and *Diamagnetism*?

5. Ampère admits that Magnetism is one form of Electricity. Certainly, but what form is it, how are are its curves produced and how can steel hold its magnetism permanently while iron cannot?

6. Has any one ever yet received an exact idea of what is meant by positive and negative Electricity?

7. *Is Electricity a cold or warm principle? If cold, why does it sometimes produce the greatest heat known to man? If warm, whence its contractive power?*

8. Electrical science, then, is still in a *vague* condition and the unfortunate thing about it is that many writers on the subject are quite unaware of its imperfections and affirm that "*all* the facts of Electricity can be explained by either Franklin's or Dufay's theory." We have seen that none of the leading facts can be exactly explained by them.

V. Gravitation.

1. But how about *Gravitation*? Cannot scientists explain this ubiquitous principle? Are all possible objects saturated with it, and yet nothing known of how its potencies are exerted?

2. Some say that *magnetism* is the secret, each sun and planet being an immense magnet. But magnetism and gravitation must be vastly different things, 1st, because magnetism reaches only

a limited number of substances, while gravitation affects all matter; 2ndly, gravitation is incomparably swifter than magnetism; 3dly, gravitation, so far as we know, reaches out over infinite space, while magnetism is very limited in its range; 4thly, a magnet is powerful in certain parts, and powerless in others, while, in the case of gravitation, all objects of equal density attract in every direction and from every part.

VI. Physiology and Psychology.

1. But there is a vast *Physiological* and *Psychological* world which still lies buried in mystery. What is the exact process of *nervous action, muscular action, vascular action, phrenal action?*

2. *What is the exact office of the right brain, the left brain, the inner white brain, the outer gray brain, the different parts* of the *cerebrum*, of the *cerebellum, spleen, ganglia, white* and *red corpuscles of the blood* and many other parts?

3. *Through what medium does mind or volition control matter, and what is the philosophy of unconscious sleep, of conscious or somnambulic sleep, of interior, cataleptic and trance conditions*, of *statuvolism*, which enables one to suspend sensation at pleasure, of *Intuition*, that *inner reason* which works so much more rapidly than the ordinary faculties, of *intensified sensations*, of *convulsions* and many other mental and physical conditions? Massive volumes and extensive works have been produced abundantly with reference to these subjects, but who has penetrated to their inner soul of power?

VII. Light and Color.

1. We come at last to *Light* and *Color*. Great and beautiful discoveries have been made with reference to this subject, and yet is any thoughtful mind satisfied that the basic principles of color potencies, or of the action of light, have been reached?

2. "The mathematical investigations of the phenomena of light," says Prof. Hunt, "certainly go to support the views entertained by Huyghens and Young. The researches of Fresnel, Fraunhofer, Herschel and others show that a large number of facts can be explained upon the undulatory hypothesis; at the same time a great many remarkable phenomena are by no means

elucidated: and the corpuscular theory of Isaac Newton, developed by La Place and Biot, and supported by Brewster and Brougham, is capable of affording an explanation of some luminous effects which do not appear to be the result of undulations." (*Elementary Physics*, p 380.) And yet it does not seem to have occurred to this clear-headed reasoner that both of these principles could be combined.

3. In another place Prof. Hunt uses the following language: "The *undulatory theory* explains the radiant visible property of light, but it does not explain the chemical effects, the optical polarity of a crystal and its connection with the polaric conditions of its constituents—the diffraction, inflection, interferences, the oxydation of surfaces as the cause of natural colors, the presence of the chemical action of light, the presence of heat, electricity, magnetism; yet light produces all of these phenomena; it vitalizes and the organic action of light is witnessed in the fauna and flora around."

4. *Grove* ascribes light to a "vibration or motion of the molecules of matter themselves, rather than to a specific ether pervading it, just as sound is propagated by the vibrations of wood, or as waves are by water."

5. *Fencken*, speaking of the undulatory theory says: "The correlates of light, as Grove designates heat, electricity, magnetism and the gravitation of cosmic bodies, the motion in space stand begging at the door of this theory, wholly unexplained save by long and short waves, or waves vibrating at angles different from the axial plane of direction. Molecular action, what becomes of *it? Or are there many ethers*, (asks Grove,) which co-exist and pervade space? If not, we are driven back to allow to one group of dynamical forces, molecular action—to others, wave undulations, a perplexity it is hard to get rid of, a difficulty it is impossible to clear away." (*Light, Color, Electricity and Magnetism*. p. 50.).

VIII. Colors Must be Formulated by Law.

That is, we have seven leading colors in sunlight, each of which is made by a special style and number of vibrations, and when separated by the spectrum occupying exact mathematical

laws. How is this done? Have we small atoms and fine vibrations for the violet and coarser ones for the red? Is there a single ether which the sun divides off into seven different but exactly proportioned waves? How could the sun accomplish such a thing! As well fire off a cannon, and expect to have its roar divided into the seven musical tones of the octave. When we make a musical tone, it must be done by means of some exact length and number of waves in a given time, all of which must be generated through different sized tubes, or on different sized vibratory cords, etc. Should not writers on optics begin to inquire what kind of tubes or cords nature uses in so beautifully systematizing the color-waves of light? For development of this point see Chapter Eighth, VII.

IX. How is Light Projected so far?

1. If light is composed of luminiferous *ether waves*, why do they spread laterally like the hands of a clock, instead of moving forward like waves of water, or waves of air, in producing sound? Besides if there is no power to draw these solar ethers onward and assist them to continue their movements, how can they be kept moving through all the 95,000,000 miles from the sun to the earth; yes, and through the quintillions of miles beyond the earth, through which the telescope can penetrate? Sir John Herschel says there are stars so distant that their light must have been moving two million years to reach us. Now by what process is a wave to be kept rolling for such a length of time? Is there anything in waves of water to suggest a duration of millions of years or even of millions of seconds?

X. How Explain Chromatic Phenomena?

But these luminiferous waves must differ from the atmospheric waves which produce sounds in other respects, especially as the effect of the seven degrees of the chromatic scale is quite different from that of the seven degrees in the musical scale. The waves of sound produce a more and more cheerful and exciting effect as they proceed through the scale from the grave bass to the enlivening tenor of the upper notes, while the color-notes grow more cheerful until they reach the yellow, after which the pro-

gression changes, each color becoming more and more grave until it reaches the dark violet. Nature's unity is so absolute throughout all her departments, that the same general law produces the same general effects everywhere, the difference being only in degree. A true theory of colors will entirely explain this discrepancy.

XI. Chemical and Therapeutical Properties of Color.

1. Great vagueness still exists as to the *properties* of the different colors as well as their *material* and law of production. The violet end of the spectrum, including the black for a distance above, was noticed to have peculiar powers to blacken nitrate of silver, and was often called *actinic* or *chemical*, but Prof. Draper, Vogel and others showed the great chemical power of the yellow color in bringing about the decomposition of carbonic acid in the leaves of plants, and it will be abundantly shown hereafter that one end of the spectrum is chemically as powerful as the other. Scientists are approximating gradually a more correct knowledge of the colors, but do not seem to know why the blue and violet rays have such powers to germinate seeds and cause such immense activity in vegetable growth, and do not explain why these same cold colors can, with certain other colors, cause far greater heat than those of the warm red end of the spectrum itself when taken alone. In fact, they seem to deny, as did the great Newton, that the different colors have any special well-defined potencies. In his day, such a mistake was much more excusable than at present, when we have the wonderful revelations of the spectroscope to assist us.

2. As to the marvelous *therapeutic character of colors*, most of our works on the subject are silent, and our physicians themselves are generally but little acquainted with it. In fact General Pleasanton of Philadelphia, though not pretending to give any science of colors, has given a better summary of facts concerning the healing power of one portion of them, namely "Blue and Sun-lights," than any medical or other work with which I am acquainted. Since writing the foregoing sentence, Dr. Pancoast's "Blue and Red Light," has appeared, which is somewhat more accurate than Pleasanton's, in a medical sense.

XII. Shadow is an Entity.

So far as I know, it is the universal opinion of the scientific world that *shadow or darkness is a nonentity, being the absence of light, and that cold is also a nonentity, being the absence of heat. The utter falsity of these positions can be demonstrated.*

XIII. Correct Science requires a Knowledge of Atoms.

One of the most unfortunate things for the scientific world is that the law of atomic action has never been ascertained. All science both of the visible and invisible must be deficient in its fundamental principles until it is known how atoms combine and work. Atoms have amazing activities and chemical potencies, but how can we get into the real knowledge of light, color, electricity, magnetism and force of every kind as connected with matter, unless we know how matter itself is constituted? When we know more of matter we shall know more of force, and vice versa. Faraday says that "we know nothing of atoms;" Attfield's chemistry says that they are centres of "a force of enormous power," while Tyndall and many other eminent scientists have given extensive study to them. Until we understand these atoms in at least their basic principles, all theories of science must have more or less guess work.

XIV. The Dynamic and the Material or Fluidic Theory.

1. But that which seems to me as one of the greatest of all errors and which has kept the true knowledge of atoms and all other departments of nature in the back ground, is the *one sidedness* of the prevailing theories of force. If scientists would remember that all things have dual relations, *a soul and body principle*, as it were, it would save a vast number of errors.

2. There are two great theories afloat called the DYNAMIC, on the one hand, and the MATERIAL or FLUIDIC theory on the other. Dynamic means spirit-like, and is supposed to be a power inherent in atoms themselves, causing them to vibrate aside from all fluidic or etherial elements as vitalizing forces, or as Tyndall defines it, "An accident or condition of matter; namely a motion of its ultimate particles." (*Heat as a mode of* motion, p. 39.) while the believers in the *fluidic theory* advocate the flow of fine

ethers as the sole power, seemingly forgetful of the atomic vibrations which must result from this flow and also of the atmospheric undulations which must modify the light and other forces, and including *Newton's emission theory of light, the caloric theory of heat, the flow of real fluids in electricity, etc.* Scientists have swung sometimes to one extreme and sometimes to the other, but it does not seem to have occurred to them that both theories must be combined if nature's ordinary principles of force are to be obeyed. At present, the dynamic theory is most generally received, and this seems to imply the exertion and continuation of a force without any special *instrumentality* as a motive power.

3. I believe I am safe in affirming that *there is no such thing in the known universe as the exertion of power without fluidic action.* A *windmill* is run by the fluid called air; a *water wheel* is driven by the fluid called water; a *steam engine* is driven by its gaseous fluids; in all *animal and vegetable life* such fluids as blood, sap, gases and judging by all analogies, the finer life fluids prevail; *flood-wood* is carried along a stream and water is the fluid; a whirl-wind carries dust into the sky and air is the fluid; *chemical solutions* of every kind take place but water or some other fluid must be the instrument; *vortexes* swallow up vessels and countless other objects by means of a fluid; the clouds are wafted by the aerial fluid; a stream may sweep a mass of debris against a dam and hold it fast, but the element of power is ever a fluid; some wonderful power seems to drive and hold the atoms together in the tremendous cohesions and chemical affinities that rule in solids; is it supposable that this is done without a fluid? Shall we fight against all analogies in the mechanics of nature and man, to carry out a theory? Shall we not reason from the known to the unknown in harmony with nature's infinite unity? Shall we trample upon this great law of things by means of which a thousand mysteries may be cleared away and a host of new truths discovered?

XV. Faraday.

1. This prince of electricians and a grand investigator in the field of truth, furnishes an example of the difficulties which must ever occur when we look at things one sidedly or in other words when we try to consider the *soul of force apart from its body, or*

the body apart from its soul, and because he could not detach the soul of electricity from its body he concluded it had no soul, as the following words will signify :

" Another ever present question in my mind has been whether electricity has any actual and independent existence as a *fluid* or *fluids* or was a mere power of matter like what we conceive of the attraction of gravitation. It was in attempts to prove the existence of electricity separate from matter, by giving an independent charge of either positive or negative power only, to some one substance, and the utter failure of all such attempts, whatever substance was used, or whatever means of exciting or evolving electricity were employed, that first drove me to look upon induction as an action of the particles of matter, each having both forces developed in it in exactly equal amount." (*Experimental Researches in Electricity*, p. 363.)

2. I will simply remark with reference to the above, that having ascertained the law of atomic action in connection with etherial forces, I have found it a simple matter to account for the different phases of electricity and magnetism. By multitudinous facts and deductions which seem entirely irresistible, I find that positive and negative electricity, frictional electricity, galvanic electricity, thermo electricity, magnetism, and diamagnetism consist of various grades of electricity which move through atoms in the same general manner, while the variations of phenomena proceed from the different manner in which the atoms are polarized and combined.

3. The fluids alone which may be called *electro-ethers* are not electricity. This special kind of atomic vibration, which will be explained in the next chapter, constitutes the *principle of electricity*, or the *dynamic* side of the question, the fluid itself constitutes the *element of electricity* or the *material* side of the question, while both together constitute electricity. Thus does Nature's plan ever take the golden medium between extremes, or rather it includes the extremes.

4. The term *Material Theory* is hardly proper as contradistinguished from the term *Dynamic Theory*, as the latter deals with matter just as truly as the former, and having less to do with the spirit-like ethers that penetrate and vitalize the coarser elements, is really a grosser conception.

XVI. Lord Bacon,

In the second book of his "Novum Organum" says that "heat itself, its essence and quiddity, is motion and nothing else." Motion of what? Can there be motion without something to be moved, or without some instrument through which this motion must come? (See Chapter First, XVI). This point however, will stand out more clearly in the next chapter.

XVII. Locke and Tyndall.

The following passage from Locke is said by Prof. Tyndall to be stated with "singular felicity:"—"Heat is a very brisk agitation of the insensible parts of the object, which produce in us that sensation from whence we denominate the object hot; so what in our sensation is *heat*, in the object is nothing but motion." The error in this consists in confounding the *sensation* or *perception* of heat with heat itself, or an effect with a cause. Real heat is in the object itself rather than in the mind which perceives it, and produces all the effects of heat, such as melting, scorching, expanding, disintegrating, etc., without reference to the *sensations* which any animal or human being may receive therefrom. We might as well say, what in our sensation is color, in the sunlight is nothing but motion, consequently there would be no such thing as color if people should happen to be born blind, although the sky might glisten with rainbows.

XVIII.—Kant, Fichte, Schelling, Hegel, etc.

1. This one-sidedness of conception is carried still farther by the German idealists. Kant considers that *space and time are mere conditions of our own perceptive faculties and that we cannot know anything of the external* world *truly, but must simply recognize certain delusive appearances, while* Fichte *denies the existence of anything excepting man and his own consciousness.* Dr. Buchanan calls their doctrines the climax of pure absurdity, and yet Schelling and Hegel go still further into this intellectual chaos.

2. Now I would ask if this dynamic theory is not leading the brilliant scientists whom I have quoted, and many others, toward

the same absurd extreme? The most plausible argument in favor of the dynamic theory of heat has been presented perhaps by Count Rumford, but his points can be answered more easily in the next chapter, after we have considered ethereal and atomic forces. After all I cannot blame these eminent men for having unsatisfactory theories of force so long as no distinct conception of atomic action has been presented to the world, for it is hard to conceive how ethereal forces can sweep through atoms, unless it can be shown that there are powerful elements of suction in the atoms themselves, which draw these forces onward at the same time that they are being vitalized by these forces.

3. If the reader shall find my *etherio-atomic law* in harmony with established scientific facts, and a key to unlock many of the mysteries of force, thus leading us some steps higher up the infinite ladder of causation, I here confess that I could never have made this discovery by my own unaided power. The achievements of scientists, considering the incorrect system which they have followed, have been truly amazing, and I should by no means dare to present a theory to the world which would not harmonize with their leading discoveries. I have had to sit at the feet of Newton, the Herschels, Faraday, Kirchhoff, Bunsen, Ångström, Tyndall, Darwin, Lommel, Huxley, Schellen, Huggins, Brewster, Lyell, Reichenbach, Helmholtz, Elliotson, Crookes, LaPlace, Davy, Austin Flint, Jr., Draper, Ampère, J. R. Buchanan, and many others. I had to test my atomic Key by their light and my own experiments, and having become satisfied that it is correct, find it will often unlock doors into which my masters themselves have not penetrated.

XIX.—The Laws of Optics, Refraction, Reflection, Absorption, etc.

Transparency, and Polarization of Light seem to be but dimly apprehended. Gold is said to be yellow because it *reflects* the yellow and *absorbs* the other colors. What property is it in gold which accomplishes such a result? What principle in sodium makes it give out a yellow flame? What are the general properties, both chemical and therapeutical, of blue flowers or fruit, of yellow, purple, red or other colored substances? A true knowledge of this subject should enable a person to pass through

forest and field and tell the leading properties of plants and flowers and mineral substances, by their *colors* and often by their *forms,* without having to kill or injure so many persons by experiments upon them. By this I do not mean to say that experiments are unnecessary; for *theories should be tested by experiments and experiments by theories* if we are to make swift and correct progress in Knowledge, but I do say that by the aid of a true philosophy of force the experiments could hit the mark with far less blundering.

XX.—New Worlds of Light and Color.

Finally *there are new and surpassingly beautiful worlds of color* which seem to be almost entirely unknown to our writers on Optics, but which can be demonstrated on scientific principles and by abundant facts and observations. These colors reveal the very dynamics of nature and man, and the most exquisite and interior principles of force which reach far into the mysteries of mind and matter. They help to make a science out of what would otherwise be guess work, broader than mere *physics,* broader than mere *metaphysics,* and combining both on nature's great law of duality to form the grander science of Psychophysics.

XXI.—Summation of Points.

To *review* our ground, then, we see, that notwithstanding *all the brilliant achievements of science, the fundamental principles of Cohesion, Chemical Affinity, Electricity, Magnetism, Diamagnetism, Gravitation, Physiology, Psychology, Light, Color and other departments of knowledge are unknown—that the cause of this deficiency is the failure of scientists to ascertain the atomic constitution of things and their ignoring of the dual nature of the universe in their efforts to divorce matter from force, or force from matter, or at least in their swinging to the extremes of the dynamic theory on the one hand, or the material theory on the other, while the whole known mechanics of nature teach this great lesson, that all force must act through relatively static and fluidic conditions of matter, the finer fluidic conditions vitalizing the more stationary conditions, and the more stationary conditions reacting upon and answering as a base*

work for the fluidic conditions. In closing I will simply add that there are many grades of fluidic and also of relatively static conditions, the coarser grade of the static being acted on by the coarser grade of the fluidic, a still finer grade of the static by a finer grade of the fluidic, and so on upward toward the infinitely fine. A slower fluidic force may also be vitalized by finer and swifter fluidic forces. See Chapter First, XVI.

CHAPTER THIRD.

THE ETHERIO-ATOMIC PHILOSOPHY OF FORCE.

I.—Atoms.

Atoms are the primary and indivisible particles of things. To understand them fully would be almost to understand infinity. In fact we cannot understand the exact nature of the simplest object without apprehending its atomic constitution. We shall not be real philosophers until we can reach far back toward primates and thence onward toward ultimates. We shall be but poor chemists so long as we cannot tell the law of atomic action in any substance whatever, or the basic principles of chemical affinity.

II.—Force.

Force is a leading phenomenon of the universe. Without it, all movements of worlds, all chemical affinities, all wonders of light, color, sound and motion, all attractions and repulsions, all life, human, animal and vegetable, in fact every impulse of thought or affection itself must forever cease. Happy shall we be if we can get even a glimpse of its basic principles, for force and matter include the sum of all things.

III.—The Size of Atoms.

The infinity of *smallness* in nature is quite as wonderful as the infinity of *vastness*, and equally beyond all human comprehension or flight of imagination. Persons of large conceptions which lead them far into the grasp of things as they are, are often called *visionary* by those of smaller conceptions, but the grandest visions and stretches of thought are tame and small

compared with the realities of things. Ehrenberg, who investigated the subject of infusoria very extensively by means of the microscope, estimates that an ordinary drop of water, one-twelfth of an inch in diameter, may contain 500 millions of these animalcules, and remarks that "all infusoria, even the smallest monads are organized animal bodies and distinctly provided with at least a mouth and internal nutritive apparatus." As each of these must have some tubing and fluidic circulation it would doubtless be safe to estimate its number of atoms as high as 1000. This would make the number of atoms in the animalcules of a drop 500,000,000,000, besides the countless atoms which compose the water itself. The atmospheric *bacteria* are still smaller, as other scientists have shown. Thompson, by means of numerous experiments, has established the fact that in transparent bodies the atoms are so small as to require 250,000,000 to 5,000,000,000 to extend one inch, and Gaudin calculates for the smallest particles of matter figures much the same as those of Thompson, making the number of atoms for a large pin's head about 8,000,000,000,000,000,000,000 (8 sextillions) which, if measured off at the rate of a million a second, would take over 250 million years to complete! This taken in connection with the wonderful and beautiful character of each atom becomes one of the most amazing facts in the universe. But even this is doubtless far below the infinitude of nature's smallness, as the finest ethers must have atoms quite transcending in minuteness all measurements, or comprehension of the human mind.

IV. The Form of Atoms.

1. In the first place atoms are evidently not spherical, as some have supposed, as they would not combine thus properly, and would not so well carry out the law of positive and negative conditions without which all life and action must cease. This will be shown hereafter.

2. The lines of *atomic force*, are doubtless not in circles, this being contrary to the general untrammeled movements of nature, as the pathway of missiles, cataracts and planets is in the sections of a cone.

3. Some philosophers, believing with Bishop Berkeley that

the whole universe is spiritual in its nature, conclude that atoms must be spiritual, or mere circular forces which in some way overlap, combine and crystallize into the forms which we call matter. Others, believing with Hume and Büchner, that matter is the beginning and end of all things, of course consider the atoms merely material.

4. We have seen the folly of these extreme positions in the last chapter, and having learned that everything possesses a finer positive principle, and a coarser negative principle, we may confidently presume that each atom has its imperishable framework, with the definiteness of position which is supposed to belong to materiality, and yet an inconceivable exquisiteness, elasticity and spirit-like freedom and flow of force.

5. *What, then, are the lines of atomic force?* Let us see if we cannot find a suggestion by noticing what are nature's great lines of force. Our sun, as we have seen, is moving around some greater sun. This greater sun is also moving onward, probably around some still greater centre, and carrying our sun with it. Our sun, under this double motion, then, must describe a vast spiral through the heavens. Again, our earth moves around the sun, and at the same time is carried by the sun around *its* centre, making a smaller spiral somewhat less than 200,000,000 miles in diameter through the heavens. Then, finally, the moon makes its baby spiral of about half a million miles in diameter around our earth. Thus we have first the great *solar spiral*, then the *telluric spiral* around the solar, then the *lunar spiral* around the telluric, three distinct gradations on nature's favorite trinal plan.

6. Let us suppose now that atoms are in *ellipsoids*, or rather in the modifications of this form in the *ovoid*, which, as we have seen, in Chapter First, is the most easy and beautiful of simple enclosed forms. "What nature does generally is beautiful," says Ruskin, and atoms being the most general of all things, we cannot suppose them for a moment to be anything but beautiful. So far, it may be said, we are building on mere supposition, but it will be shown more and more as we advance that there is a necessity for this form. One thing in proof of this is the fact that atoms will combine and polarize better by having a smaller end, while, as will be shown, the law of positive and negative action forces one end to be smaller than the other.

7. *But where must the lines of force run, over or through this atom, or both?* Let us see. We have ascertained in Chapter First that the spiral, itself the most beautiful of continuous forms, is the great leading law of motion in nature. Let us presume, then, that the spiral direction rules in atoms as well as in worlds, especially as, according to the great unity of law, we must judge the unknown by the known. In fact the spiral is a necessity if we are to get any continuous lines around the atom and have it progress regularly so as to cover its whole form and then convey its force over to the next atom. So far, then, we have the external atom clad with spiral lines of force, or rather, a spiral framework, and tube-work through which, and over which, this force must vibrate and flow.

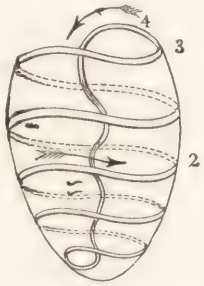


Fig 132. Outline of an Atom.

8. Fig 132 gives a simple representation of this atomic coil or helix, commencing below and moving round and round the atom from left to right, until the other end at 4 is reached. Let us first consider the effect of this external spiral movement which sweeps around with inconceivable rapidity. It is a well known fact in electricity and magnetism that when the conducting wire is wound in a spiral coil, its *heat producing power* is greatly increased. Another fact which harmonizes with the same thing is that the greater the heat, the greater the expansion, other things being equal, and here we can see just how it is that heat produces expansion, for the more powerful the sweep of forces around the atom, the more it will increase the outward or centrifugal force. One leading principle for the development of heat is that there shall be obstacles to overcome, or a laboring style of movement, and this explains why this ever twisting movement of the spiral is the distinctive one for heat.

9. Let us see how the line of force would work as it vibrates this exquisite wire-work which is untold millions of times finer and more elastic than any wires of copper or steel. Commencing at 1 it gets under greater and greater momentum until it swells the atom out to its greatest size at the middle or a little beyond, and then becoming gradually spent, the coil grows smaller at 3, and reaching the larger negative end at 4, the

heat-force of the other end is felt through the axial portion and draws it in through the middle of the atom to the smaller end, where the circuit is recommenced.

10. This current of force through the centre of the atom, acting like any fluid under the same circumstances, becomes a vortex and tends to draw the other portions inward by its suction. This, without doubt, is the *principle of cold* as is proved by the following facts:—1st, it is contracting in its nature, and cold is contracting; 2dly, it moves in the opposite direction from heat which shows why the needle of the galvanometer, connected with the thermo-electric pile, moves in one direction for cold and another for heat, as Tyndall and others have often noticed; 3dly, the swifter the movement of the forces, the more narrow, piercing and contracting is the stream, and this harmonizes with the known effects of cold, which is piercing and contracting in proportion as it becomes intense; 4thly, as a great principle of equilibrium in nature, it is necessary that one part of atomic force should develop cold in a way to balance the heat action, and 5thly, the flow of forces could not be kept up at all were it not for the law of cold, to intensify the law of heat, just as the heat intensifies the law of cold, as will be seen more clearly hereafter.

11. But in order to work properly, there must be a more intense heat-action at the smaller end in order to draw in the forces that reach the negative larger end from the outside. How can this be effected? Is not the heat the greatest at the larger part of the atom where the spiral is most expansive and intense in its action? Yes, so far as this spiral is concerned, but there are other processes by which this may be caused. As nature ever deals with gradations of refinement, and as in the solar system we see three grades of spirals with the smallest encircling the next larger, and this larger encircling one still larger, so we may presume that the atomic system continues the analogy and has different grades of spirals also. The fact also that there are known to be so many grades of force, would argue in favor of different grades of fineness in the atomic coils.

12. Fig 133, presents the main spiral which passes around the atom, then a sub-spiral which encircles the main spiral. This may be called the *first spirilla* or *little spiral.* Judging by



Fig 133. Piece of Atomic Spiral with 1st 2nd and 3rd Spirillæ.

nature's usual law of trinal gradations there is probably a still finer spirilla that encircles this first one which may be called the *second spirilla*, and another which encircles the second one, more minute still, and properly constituting the *third spirilla*. The different grades of forces that flow along this spiral and these spirillæ must pass around the atom in the same direction, just as the sun, planets and moon all move along through space in the same direction, namely from west to east.

V. The Heat End of Atoms.

1. From the foregoing, then, we may now begin to see how one end of the atom will naturally become warmer than the other end, although the spiral itself may be less expanded with heat action. The first spirilla, being much more elastic than the spiral, must spring into its full heat action and power near the positive end, say at 1, and the 2d and 3d spirillæ still sooner. These become more exhausted and feeble at 2, near the negative end, after having imparted their force to the spiral. That is, the 3d spirilla, being most active, quickens the 2d, the 2d quickens the 1st, and the 1st quickens the spiral itself.

2. Another method of intensifying the heat of the positive end is to have the spiral lines nearer together there than at the negative end, as in fig 132, a method which nature probably adopts, as it is absolutely necessary to have the positive and negative distinctions well emphasized to attain the highest power. Does the reader see this important point? By having the external positive end hot it draws all the more powerfully upon the axial current within and thus intensifies the cold, and then again the swifter the cold-producing currents the more will they react and draw upon the heat-currents on the external atom, other things being equal. Thus beautifully does nature develop her intensity of life and action, by causing one extreme to vitalize and balance the other. Action on any other plan would be ruin, or rather action without positive and negative forces would be impossible, and so universal death would ensue.

VI. Nature of Atomic Spirals.

1. As in animal life there are millions of tubes, such as lymphatics, lacteals, capillaries, veins, arteries, nerves, etc., and as in all vegetable growth there are countless tubular ducts to convey the life fluids, so we may conclude that *an atom with its intensity of life-like action has its spirals and spirillæ in the form of tubes*, within which are still finer *ethereal juices* which constitute its most interior life-force. That these spirals are amazingly elastic is shown by the fact that they expand to a size 2000 times greater in ordinary atmosphere than in water, while in the upper atmosphere, and especially in the ether beyond, they must be far more expanded still.

2. The most common arrangement of atomic spirals is doubtless two-fold, as will be shown hereafter, consisting, 1st, of coarser and more external groups of spirals such as 2 and 4 in fig. 134, which may be termed *extra spirals*, and 2dly, finer spirals set farther in, such as 1 and 3, which may be called *intra spirals*.

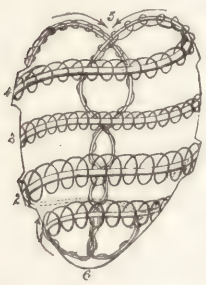


Fig. 134. Extra Spirals and Intra-Spirals.

The need and existence of these will become more and more apparent as we advance, besides fulfilling nature's analogies. Instead of there being but one intra-spiral at 1 and 3, or but one extra-spiral as at 2 and 4, there is probably a gradation of several of them placed side by side in all the more complex grades of atoms, say from 3 to 7 in each place. The need of seven spirals in all *transparent* atoms, in other words in atoms of substances which transmit all the colors as in transparent bodies, will be evident. The *positive intra-spirals* are grouped at 1, the positive *extra-spirals* at 2, the *negative intra-spirals* at 3, the *negative-extra spirals* at 4, the *atomic vortex* into which the spirals all sweep with vortical whirl is at 5, the *torrent* at which the forces become most pointed and swift is at 6, and the *axis* or *axial current* from 5 to 6. The curves caused by the vibration of spirals are not shown in the cut, nor are any but the first of the spirillæ given and shown as they must be in nature, and there are doubtless points of connection between spirals, spirillæ and all other parts of the atom which make it a complete unity.

VII. General Features of Atoms.

1. Years of investigation of what the general form and constitution of atoms must be to harmonize with and furnish a key to the facts discovered by the scientific world, aided by many more years of inquiry into the fundamental principles of nature, have led me to a very positive conclusion that fig. 135 is the general outline of an ordinary atom, especially of one by means of which all the colors can be made manifest. The hundreds of points to prove it correct cannot be given here, but they will appear more and more all through this work in the mysteries which are cleared up thereby, especially in Chapter V. as well as in this chapter. Although the modification of tints, hues and other forces which are manifested through atoms is almost infinite from the fact that atoms of the same substance must vary within certain limits in the size of their spirillæ of the same kind, yet facts seem to indicate seven intra-spirals (4) on the outside of atoms for the warm or thermal colors, and which are properly the *thermo-lumino* group, whereas the same spirals form the principle of the electrical colors while passing through the axis of atoms. These are all named and located in fig. 135, commencing with the largest spirilla for the hot invisible solar rays called *thermel*, after which is the slightly smaller spirilla for red, another for red-orange, etc. Passing around the atom and becoming smaller and finer, the same spirillæ form the channels for the electrical colors by passing into the vortex and through the axis, thermel being converted into blue-green, red into blue, red-orange into indigo-blue, orange into indigo, yellow-orange into violet-indigo, yellow into violet, and yellow-green into dark violet. The group of thermo-spirals at 3, 3, are called *positive*, because the spirillæ that surround them are larger and the heat greater than the portion of the same group at 5, 5, which are therefore called *negative* thermo-spirals. The group 2, embraces the positive color-spirals, but as they are concealed by gliding into the contiguous atoms, it is only the same group at 4 that are visible as thermo-color spirals, or at the vortex above as electro-color spirals. 9 and 10 represent minute streams of ether, which are simply combinations of much finer atoms, that flow from the thermo spirillæ and the thermo-lumino spirillæ into the same grades of spirillæ in the atom above ; 7 and 9 are axial ethers which flow from the atom

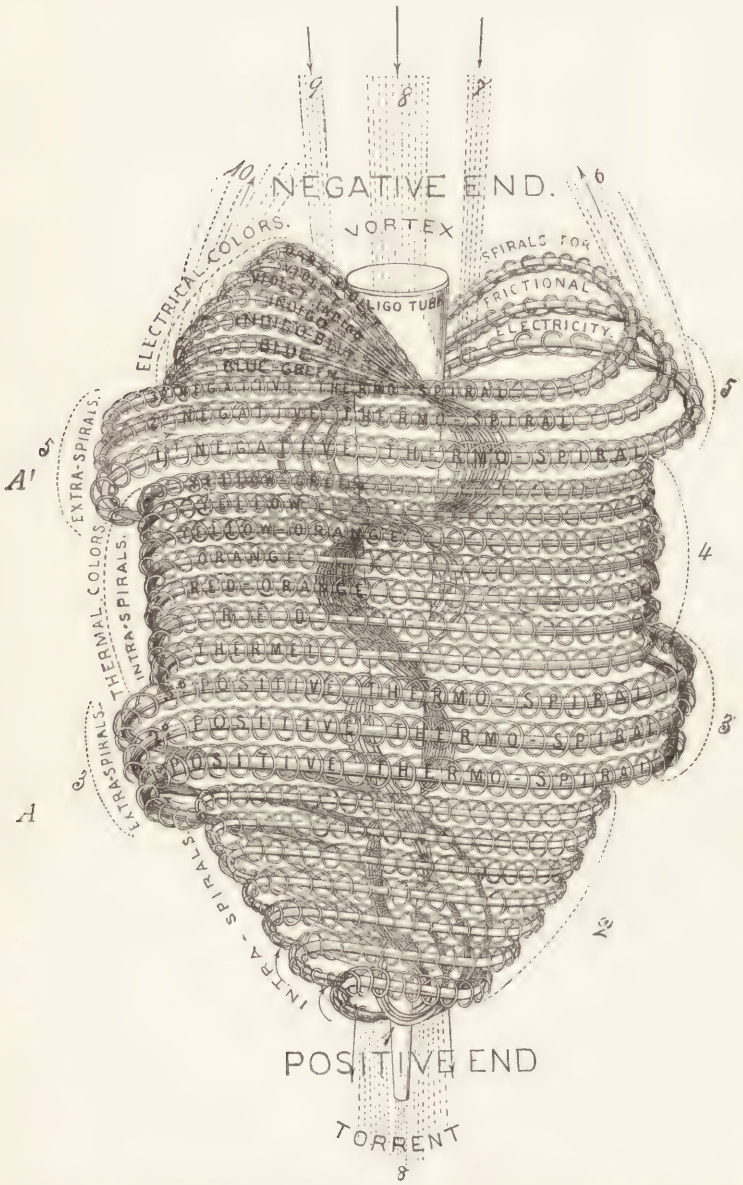


Fig. 135. The general Form of an Atom, including the spirals and 1st Spirillæ, together with influx and efflux ethers, represented by dots, which pass through these spirillæ. The 2d and 3d spirillæ with their still finer ethers are not shown.



Fig. 136.
Atoms joined.

above into the axial spirillæ of this atom; 8 represents ethers which flow through the *ligo tube*, and these and other ethers are represented as passing on through their appropriate channels until they emerge at the torrent end. These ethers sweep through the atom and quicken its spiral wheel-work into new life, just as the winds move a wind-mill, or the waters a water-wheel, while the atom itself, armed as it is with its vortical spring-work, must have a great reactive suction which draws on these ethereal winds.*

2. Why are ethers drawn from spirillæ of one atom to the same kind of spirillæ in a contiguous atom, and why does a certain grade of ether exactly harmomize with, and seek out, a certain size of spirilla? For the same reason that a tuning fork or the cord of a piano will be set into vibration by a tone made in its own key. In the case of a piano, a cord vibrates to tones of its own pitch, or in other words, to tones whose waves synchronize with its own vibrations. Let us apply this principle to atoms. The vibratory action of the red spirilla throws the current of ether which passes through it into the eddy-like whirl which just harmonizes in size and form to the red spirilla of the next atom above it with which it comes in contact, and which must necessarily draw it on. This second atom passes it on to the red spirilla of the third, the third to that of the fourth, and so on through millions of miles, so long as there is a spirilla of the right grade to conduct it onward. The same process applies to the orange, or yellow, or any other spiral, and, constituting as it does a fundamental principle of chemical action, the reader should note this point well. The same principle applies to the axial spirals whose lines of force, reaching the positive end at 1, make a sudden dart to the outside and thus in part *jolt* their contents into the answering spirals of the next atom, the blue ethers of this plunging into the blue spirilla of the next, the violet ethers of this into the violet spirilla of the next, and so on.

3. The ethers are *efflux* as they flow out of one atom or series of atoms, and *influx* as they flow into an atom or series of

* As will be shown hereafter, there must be still finer atmospheres within the ordinary atmosphere, so fine doubtless that they permeate solids and fluids, and form a base-work for fluidic action which may assist the spiral eddies and vortical suctions of the larger atoms.

atoms. Thus 9 and 7 are influx, and 6 and 10 efflux ethers. The ethers at the torrent end are powerfully efflux, and have momentum not only from the projectile force of this atom, but from the suctional force of the next, into whose vortex this atom is inserted.

4. It should be noticed that the same spirillæ which wind around the outside of atoms on the expansive law of thermism, pass on through the axis on the contracting law of cold, and after becoming the most contracted and intense at the positive end of the atom, suddenly plunge to the outside and again become thermal. Thus the very intensity of the interior cold forces may develop intensity of heat, and we at once see why it is that an object which is so cold as to be 60° F. below zero is said to have an effect similar to that of red hot iron.

5. The *First Positive Thermo-Spiral* at *A* projects beyond the intra-spirals below and forms a regulating barrier to determine just how far this atom shall be inserted into the vortex of the next atom: in other words, this atom becomes sheathed in the next as far as *A*, while the atom above becomes encased in this precisely the same distance, and so on, which accounts for the great regularity of form in crystallizations, etc. In chemical affinity, as I shall show hereafter, the atom glides into a wide mouthed atom up to its *shoulders* at *A'* where the second circuit of these same thermo-spirals is seen. By this means the color-spirals are hidden in the encasing atom, and this explains some mysteries of color change which puzzle the chemist, and which will be explained in Chapter V.

6. The *Ligo* is supposed to exist only in solids, such as rocks, metals, fibrous substances, etc., in which it forms the leading element of cohesion and hardness, while in liquids, gases and ethers it is wanting, which accounts for their flowing qualities. This tube probably has spiral convolutions with openings in the sides something like those Chimney pieces, the object of which is to cause a draft.

7. The seven thermo-lumino spirals which become the electro-lumino spirals on reaching the vortex and axial portion of the atom, naturally grow somewhat smaller, from the smaller space in which they move, and receive a finer grade of ethers from the axis of the atom above at 9 and 7 than those which course

through them in their thermal portions on the outside. As they progress through the axis they become narrower, more nearly straight and consequently more keenly electrical until they reach the torrent end. The reason the dark violet is the coldest of all the colors is, because from its position it must circulate with a more narrow and interior course through the axis, as being the highest (See fig. 135), it reaches the vortex and enters before the others, next to which comes the violet, then the violet-indigo, the indigo, the indigo-blue, the blue, and warmest and least electrical of all in the electrical group, the blue-green. My reasons for calling these the electrical group of colors will be fully shown in XXIX of this chapter. *All axial forces move on the law of electricity of some kind, while the coarser grades of electricity impart the ruder sensations of cold, which are so distressing. The finest grades of electricity, while producing the phenomena of cold, such as contraction, do not impart the chilling sensations of cold at all, to most persons.* To compose all the colors which constitute white light, both the electrical and thermal colors must be combined and carried along side by side through conversely polarized lines of atmosphere, or other media, through which they are conveyed.

8. The axial spirillæ doubtless fill up the whole interior of their atoms from their elasticity, which fact the artist has not quite expressed.

VIII. The Thermo Spirals,

So useful, as we have seen, in regulating the joining of atoms according to absolute system, have other important qualities. They are important factors of heat or thermism in its ordinary coarser grade, and when moving axially constitute the principle of *frictional electricity* (See XXV). These being extra-spirals, and consequently the most external of all, it is easy to see why friction or pressure begets heat as well as electricity. It is easy to see, too, why frictional electricity moves especially over the surface of bodies as these spirals are so projecting as to strike very freely against all surrounding atoms, consequently their movements are smothered before they reach any considerable depth below the surface. These extra spirals would naturally

emerge from the axis of atoms on a side opposite to that from which the intra-spirals emerge, to maintain an equilibrium of forces, and would also pass into the vortex on the opposite side.

IX.—Ethereal Forces.

1. We have now seen that an atom is a wonderful little machine with wheels within wheels, a miniature world through which are manifested the principles of all power both on the earth beneath and in the heavens above. But how is this machine made to *run?* How do these atomic springs keep up their ceaseless motions, their amazing vibrations, millions of millions of which take place in a second of time, as for instance in light? Has such a thing ever been heard of as a spring that will vibrate forever of its own accord? Has not science determined that perpetual motion in mechanics is impossible? We have seen in the last chapter that in all the known mechanics of man or nature, force is never propagated excepting through fluidic action of some kind. As the wind-mill must have its wind to keep up motion, so must the atom have its *flow of ethers* to keep its wheels in operation, and form different sized eddies of force. Democritus speaks of "minute atoms in swift motion which by their smallness and rapidity were able to permeate the hardest bodies." In this idea he almost reached the very key of force, showing that he had an idea of ethereal fluids without which no correct conception of nature's dynamics can ever be acquired.

2. But here it may be asked, *what keeps the ethers in perpetual motion,* for, like the more static atoms through which they move, even they must be vitalized or they will cease. While the spiral forms of the atom, when once in motion, attract the ethers with a fine suction, and while the arrangement of positive and negative portions of the atoms gives still further vitality, making it almost self-acting, still there is the edict of mathematical science which says that *perpetual motion in mechanics is impossible.* And yet nature and life are in everlasting motion and not an atom of the universe is at rest. How shall we get out of this dilemma? Let us dwell a moment on this point.

X. The Primate of Force.

We have seen that the finer and more subtile a substance becomes, other things being equal, the more potent is its character (*Chap. First, XV.*), and the more nearly does it seemingly approach self-action. We see also that the merely material universe has no power in itself of perpetual movement—that *protoplasm*, for instance, which some physicists proclaim as the starting point of all life, must be entirely powerless without some higher and finer principle beyond it: whence, then, is the power that animates all being? If matter alone proves thus insufficient for this continuity of life, are we not driven irresistibly to the conclusion that what we call spirit, must be a necessary factor? In fact is there an example that can be produced in the whole realm of being, in which continuous and self action exists excepting when some principle of spiritual force is combined with material conditions? To reach the primate of power, then, we seem compelled to mount the ladder of fine forces to those which are still finer, until we arrive at conditions so exquisite as to be able to receive directly the impress of Infinite Spirit. But Spirit itself, if we are to judge by all analogies, must *flow out* and permeate all atoms and beings on a diviner plan, though in harmony with the fluidic process.

XI. Different Grades of Ether.

1. I have been convinced beyond all doubt by numerous facts, that there are many different grades and styles of ether, and that long before I saw the suggestion of Grove. I will simply notice two or three of these facts in proof here, as the reader will see the necessity of these grades more and more as we proceed. Scientific men generally admit that there is one ether as a medium for communicating waves of light, etc. This of course is immensely elastic and has sometimes been called the Cosmic ether which is a very proper name, as it constitutes an exquisite atomic bridge-work between the starry worlds over which pass and repass the fine solar and stellar forces of all kinds, such as the different grades of light, electricity, heat, gravitation, etc. The law of atomic arrangement in this cosmic ether will be shown hereafter. In speaking of these ethers and some other

subjects, I must in some cases give simply the results of my investigations, reserving the fuller proofs for another part of this work or for a future treatise.

2. The fact that scientific men in general have not ascertained that there is more than one ether just as there is more than one grade of gases or liquids, shows how completely they have ignored the finer and mightier forces, and confined their investigations to the cruder elements principally. In 1773, La Place demonstrated that gravitation acts at least fifty million times as swiftly as light. Can anybody suppose that such a movement of force comes from waves of the same ether, without some finer element being involved? What would be thought of a person who would assert that waves of air in some cases move 1100 feet in a second, as in the production of sound, and in other cases millions of times as rapidly? But nobody will be so absurd in reasoning about visible and tangible matters, and they should use equal judgment in reasoning about the invisible. The analogies of all nature and the necessity of different grades of fluidic elements to express the different grades of force, constitute abundant proof of the plurality of ethers, as will be seen hereafter.

3. In giving the different grades of ethers, those which are generally in motion gliding through larger atoms will be represented by terms ending in *o*, but those which are more commonly stationary, or nearly so, like the water of a lake, or a quiet atmosphere, will be signified by terms ending in *ic*. The former are more *fluidic*, the latter more nearly *static*. Static ethers are of course sometimes capable of becoming fluidic, just as water may at times flow in streams, or the air be swept into currents, but I speak of their general character, which is to form a bridge-work of channels through which the fluid ethers may pass, just as polarized lines of atmosphere form channels for the solar ethers in the processes of light. But these very solar ethers, even while in full flight through space, may form the bridge-work of incomparably swifter and more subtile ethers, such, for instance, as those which cause the attraction of gravitation, and thus, for the time being, become relatively *static* though not absolutely so. My investigations have led me to adopt the following as constituting the leading divisions of ethers, progressing, for the most part, towards superior fineness as we advance.

I give them names mainly from the spirals in connection with which they move.

4. The *Thermo Ethers* flow through the *thermo spirillæ* and in connection with these, which as we have seen are the most external of all, *constitute the ordinary coarser grades of heat.* These ethers are too coarse to become visible in the way of colors, but when the heat action is very intense, as for instance in heated iron, the *intra* spirals become roused into action and manifest first the red light, then the orange and yellow light, then white light, when the iron is called white hot.

5. *Electro Ether* is the element of frictional electricity used in connection with these same thermo spirals, only on the axial portion. These spirals being the highest and most external while on the outside of atoms, must necessarily enter the vortex first and become the most interior and direct while in the axial portion, hence the swiftness and intensity of its ethers which are transmitted by the shortest pathway, and hence, also, the fact that they are more thoroughly electrical than the other elements of electricity (See XXV.). On the supposition that there are three grades of thermo and electro spirals, there must be three grades of thermo ether and three of electro ether.

6. *Thermo Lumino Ether* is used in the intra spirillæ which form the thermal colors, or in other words with the thermo lumino spirillæ. The different grades may be designated the *thermel ether, red ether, orange ether,* etc. There seem to be two distinct grades of ether for each color, and a very important principle being involved here, a few words of explanation will be necessary. The reader should remember that the seven tubes which pass around the atom constitute the thermal color-spirals, while the still finer tubes that wind around these spirals themselves, are the first spirillæ which form channels for the color ethers. Now suppose a red color ether should be thrown upon a red spirilla from the outside, what would be the effect? The finer atoms of such ether would be small enough to penetrate between the tubes of the spirilla and become a part of the interior current, while the coarser atoms, being too large to pass inside, would strike the tubes and bound off. This would constitute a *reflected red* as in a red building, while the other would constitute a *transmitted red* as in red glass. If this is true the

interior transmitted color should be more exquisite than the ordinary reflected colors, which in fact is remarkably the case, as the colors of a prism or of colored glass are so much more beautiful than those of the ordinary reflected colors seen in paints or dyes, that a young person viewing them for the first time is apt to make an exclamation of delight. The diamond is a good illustration of exquisitely fine transmitted ethers which are shown by its refractive power. That all substances have different grades of fineness is shown in Chapter Fourth, VII., 1—5. These grades can be called *transmitted red*, *reflected red*, *transmitted orange*, *reflected orange*, etc.

7. *Electro Lumino Ether* is of course that which is connected with the spirillæ of the electric colors, and may be called the blue-green ether, the blue ether, the indigo-blue ether, and so on with the other four colors. These, too, have the fine *transmitted grade* of ethers and the coarser *reflected grade*, the latter of which must bound back from the spirillæ just within the vortex. The color ethers (or in other words light), move 186,000 miles a second, or about two-thirds as rapidly as frictional electricity, as measured by Wheatstone. It should be remembered that the color-ethers grow finer as they progress through thermel, red, red-orange, orange, etc., up to dark violet and really far beyond that, although they become invisible to the ordinary eye.

8. So far we have the principal ethers which flow through a transparent substance, like glass, including the thermo ethers which flow through the *extra* spirals, and the electro ethers which flow through the axial portion of the same; also the lumino ethers, both thermal and electric, which flow through the *intra* spirals and their axial portions. There must be still finer ethers in connection with the second and third spirillæ of these same substances, but these will be understood better hereafter. But are there no other forces in nature excepting those thus far named, including light, reflected and transmitted, ordinary heat as manifested by the thermo spirals and spirillæ, and ordinary cold and frictional electricity, as manifested by their axial spirals and spirillæ? Yes, for there are different grades of electricity, such as the galvanic and magnetic among the more positive styles, and weaker negative grades of electricity, and other still finer forces which will be explained hereafter.

9. We may now descend to a somewhat coarser grade of ethers which sweep through atoms of somewhat coarser character than those that are used for the transmission of light. Iron, and perhaps a majority of opaque substances, belong more or less to this grade. Farther on in this chapter (XXXIII), facts will be adduced to show that the atoms of these substances also have their seven intra spirals in which the ethers are a little too coarse to appear as light, as well as the usual thermo spirals, through which the ethers flow as a somewhat coarser grade of caloric than that of the other atoms. The intra spirals, when they reach the axis of these atoms, have ethers which correspond to those for blue-green, blue, indigo-blue, indigo, violet-indigo, violet and dark violet of the luminous atoms, only, as I have said, somewhat too coarse to produce the effect of color on the retina of the eye. What effect do they produce, then? That of electricity of course, as they flow axially. But what kinds of electricity? We may divide them into three grades, namely, *Chemico electricity*, *Galvano electricity*, and *Magneto electricity*, or the chemico, galvano and magneto ethers in connection with their axial principles.

10. *Chemico Ether* is a lower grade of chemical force, presumed to flow through the axial spirilla corresponding to the blue-green in the color atoms and perhaps the coarser grade of blue, and constituting the feeblest style of electricity as it is more external than the other axial spirillæ. It is doubtless an element of *negative electricity*, and is quickened into decided action by sulphuric acid coming into contact with zinc, etc. See XXVI.

11. *Galvano Ether*, the element of galvanic electricity, seems to correspond with the ether for blue, indigo-blue, and probably indigo. It is finer and more powerful than the chemico grade. See XXVII and XXXIV.

12. *Magneto Ether*, used in Magnetic electricity and Magnetism. Its spirillæ correspond to those for violet-indigo, violet and dark violet, as shown by spectrum analysis. This, in connection with some galvano ether, constitutes the positive or north-pole currents of the magnet, while chemico ether is used in the feebler currents of the south pole in connection with thermism.

See Chromo-dynamics ; also Plate III., in which the odic colors are a fair test of the potencies of the magnet. Iron, the great leading metal of magnetism, when intensely heated for spectroscopic analysis, has the violet-indigo the strongest of its electrical colors, also the violet, indigo, blue, and blue-green large, which last is the element of Chemical electricity. (Chap. Fifth, XIII).

13. *Odylo-Ether*, the basic fluid of odic light and force as discovered by Baron Reichenbach, and a grade higher than the ethers of ordinary light. It flows through the 2d spirillæ of the intra spirals just as ordinary light does through the first spirillæ of the same: also through the first spirillæ of odic atmosphere just as light does through the same spirillæ of common atmosphere. (See Chap. Ninth.)

14. *Psycho Ether*, used in connection with mental action (Chap. Tenth), twice as fine as Odylo ether, four times as fine as light, as will be shown. It can pass through the 3d spirillæ of intra spirals of ordinary atmosphere, also through the 1st spirillæ of the psychic atmosphere, which form all analogies we must suppose to exist.

15. *Gravito Ether*, the central element of gravitation, inconceivably fine and swift. The reader may already see from the foregoing description of atoms, something of how its attractive processes are carried on between all bodies, all atoms of which exert their suctional forces in all directions so far as this fine ether is concerned. At some future time I shall attempt to explain the processes by which this is done, and by which some atoms become *heavy* and others *light*.

16. *Cosmic Ether*. I will mention briefly some static ethers which are signified by names ending in *ic*, as I have before said. *Cosmic* ether, from *Cosmos, the world*, is the great world-connecting ether of space, whose atoms, polarized by the light of suns and stars, become crystal railways over which light and various other forces pass. In Chapter Fourth, VIII, I have given a number of facts in proof that this cosmic ether is simply a continuation of the finer elements of the atmosphere of the earth and other orbs in the shape of an exquisite grade of hydrogen as its leading element.

17. *Odylic Ether* is the finer atmosphere within the coarser,

through which the odylo ether or odic force finds its most natural pathway. For description see Chapter Ninth, III, 2.

18. *Psychic Ether*, the atmosphere still finer than the foregoing, through which psycho ether with the psychic lights and colors makes its pathway. It is the same to psycho ether that the atmosphere is to light. (See Chap. Tenth).

19. *Miscellaneous Ethers.* There are ethers probably still coarser, and of course still finer than any of the foregoing. There is probably a very slow *Animo ether* which constitutes a vitalizing principle of animal life and the coarser grade of nerve-force. According to experiments made by Helmholtz and Baxt, the mean rapidity of the motor nerve force is 254 feet per second. As we have already seen, the lines of all spirals and spirillæ must be tubes if we are to judge by analogies. When I say the line of a spiral, I do not mean the line that passes around the spiral, for this would be the 1st spirilla, but the spiral itself. Within the spiral tube would naturally be polarized lines of minute atoms forming a static ether which may be called *Spiric*, while in the spirillæ tubes the same kind of still smaller atoms may be called *Spirillic*. These must serve a great purpose, for as they wind around in tortuous lines and are swept by the ethereal forces into countless vibrations, these internal ethers must be chafed with intense frictions which would immediately render the whole tubes alive with heat and quicken the action of the whole atom with all its grades of ether. These spiric and spirillic ethers would also be quickened and held together by exquisitely fine fluid ethers which move in endless circuits through them, and which should properly be called *Spiro-Ether and Spirillo Ether.* The *Ligo Ether*, which sweeps through the ligo and drives the atoms together into a close cohesion, must be a cold and swift current on the general plan of electricity. In order to the greatest harmony, the ethers that pass through the *channel* (not the tube), of the third spirillæ, must be twice as fine as those of a 2d spirilla, and those of a 2d, twice as fine as those of a 1st, and the size of these channels themselves, as well as the size of the tubes that form the channels, must vary accordingly. This makes every alternate wave of force harmonize, just as is done in tones which are an octave apart. This same kind of harmony is carried out in male and female voices which average

just an octave apart. The reader will understand this the better by studying the laws of undulatory harmony and discord, and by remembering that nature ever works according to the most perfect system. Let not the reader consider the foregoing nomenclature and division of ethers quite imaginary, as he will be finding facts in corroboration all through this work, and still other facts in a future work of the author.

XII. Ethers have Weight,

Otherwise they could not have momentum. It is common to call electricity, magnetism, light, heat, etc., *imponderable*, because human instruments are not delicate enough to weigh them. Prof. Crookes, however, has succeeded in measuring the momentum of light by means of his wonderful little instrument called the *radiometer.* By its means he has estimated the propulsive power of sunlight for the whole earth at 3000 millions of tons ! His instrument has given the dynamic theorists much trouble. The light of a candle he has found to weigh .001728 or nearly a 900th part of a grain. The amazing forces used in chemical affinity, such as chemico-ether, the luminous ethers, electro-ether, etc., as will be shown hereafter, sweep the atoms even of solids into every style of arrangement and polarization, and consequently must have a tremendous momentum. The etherio-atomic law demonstrates this point in a multitude of ways. Dr. William B. Carpenter, who seems to be but little acquainted with the fine forces, has written an article in the "Nineteenth Century," in which he takes the most difficult methods of explaining away the power of radiation to produce electricity and mechanical force as in the radiometer. "There is no reason whatever," he says, "for attributing to radiation any other power of exciting an electric current than that which it exerts *mediately* through its power of heating the thermopile." Even if this assertion should prove true, how can sunlight heat the thermopile, or anything else, except by the impact and momentum of its rays upon it, especially as it is admitted that radiating light has no perceptible heat of itself, excepting as it strikes something ?

XIII.—Polar Cohesion of Atoms.

I think the ground is now sufficiently clear for an understand-

ing of the methods by which atoms become polarized and combine into solids and other substances.

Fig. 137 represents two atoms polarized and joined at 1, the upper atom sinking into the lower as far as the positive thermo spirals, which thus regulate the distance. The dotted lines represent the ethers which flow axially from 3 to 5, and thermally around the atoms in the other direction ; 4, 4 shows how the ethers are drawn on from one atom to another by the eddy-like forces of the spirals and spirillæ of the same grade with which they come in contact. The ligo of the upper atom glides into the ligo of the lower, and the two thus become riveted into one, and held doubly tight by the spiral sweep of the ligo-ether. The artist has doubtless represented the upper ligo as being inserted too far in the lower ligo, as the axial spirals which encircle the upper might interfere somewhat, unless they are exceedingly elastic. But how do the atoms thus arrange themselves in this orderly manner ? Why do not the wrong ends come together ? Not only does the vortical and ligo suction of the lower atom draw the second, but the torrent or axial current above drives the second against the lower atom and holds them together. They could not possibly be joined wrong end first, as the currents would then drive in opposite directions, and repulsion would occur. They can no more avoid this arrangement under the play of ethereal forces than a stick of wood on the brink of a maelstrom can avoid being swept in. The positive end of the line is at 5, the negative end at 3.

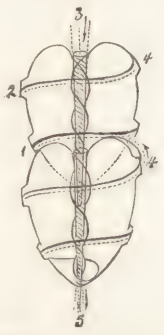
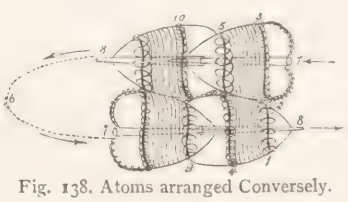


Fig. 137. Polarized Atoms.

XIV. Lateral Cohesion.

1. Having explained the mystery of polar cohesion, let us see how atoms can cohere laterally. Fig. 138 presents two lines of polarized atoms drawn with a single thermo spiral and its first spirilla. The lines are placed conversely so that a positive spirilla of one atom occurs by the side of a negative spirilla of another. If they were placed so that the eddies of two


Fig. 138. Atoms arranged Conversely.

positive spirillæ should come together, they would repel each other; but a powerful eddy placed near a feeble one would overcome it and draw it toward itself. Thus the positive spirilla 1, outdraws the negative spirilla 3 at the point 2, and so links that portion of the upper atom to the lower, while the positive spirilla 5 outdraws the negative spirilla 4, and thus holds that portion of the lower atom as firmly as the lower atom held the upper in the other case. The other atoms work in the same way.

2. Thus we see that heat action, which is generally so expansive and disintegrating, may become an element of cohesion, though a much feebler one than cold exerted through the ligo and axes of atoms in polar cohesion. This will explain why wood, stratified rock, etc., will split more easily in one direction than another. The polar cohesion is in the direction of the fibres, grains of wood, etc., while the lateral cohesion is at right angles to this. The curved line, showing how ethers may pass out of the torrent end of one line of atoms and be drawn into the vortex end of another line, will give a hint of how *magnetic curves* are formed, although it is incorrect to represent it as passing out and into contiguous lines or out and into the same layer of atoms.

3. The cut will show how atoms can communicate their impulses laterally, as from 1 to 3, as well as longitudinally from 7 to 8. The lateral movement of light may be understood by studying it, as it can never be understood otherwise.

XV. The Unity of Atoms.

Judging by all other works of nature, atoms must be united by bonds of unity through all their parts, so that all spirals must be connected more or less with all other spirals by small pillars or tubes. These may be called atomic tendrils. The 3rd spirilla imparts action to the 2d, the 2d to the 1st, and the 1st to the parent spiral itself, while each spiral is so connected with its brother spirals as to act and react upon them. Even the thermo spirals are doubtless connected with the intra-spirals; as well as with each other, by delicate tubes which are so arranged as not to impede the passage of ethers. In this way atoms are doubly armed against stagnation and death, for if only a single ether should be moving through the minutest spirilla, it would impart more or less of its vitalizing power to the whole atom.

XVI.—Converse Layers of Atoms

Are such as are represented in the cut, fig. 138, with the lines running in parallel but alternately in opposite directions. The next layer placed upon this would exactly reverse the order, and be the same as this turned over, so that the upper atoms would come on the lower and the lower on the upper. This must be the arrangement of the *cosmic ether* by means of which it is enabled to carry both cold and warm forces to and from the sun and other orbs. It is probably also the most common arrangement of ordinary matter.

XVII.—Transverse Layers of Atoms

Are those which cross each other at right angles, or nearly so, and must bind the particles into a greater *hardness or toughness* than they would otherwise have, as they are polarized longitudinally and laterally. *Steel* must be composed of *transverse* layers just as iron is doubtless composed of *converse* ones mainly. I will mention here simply two proofs of this, 1st, steel or *carburetted iron* is harder than ordinary iron; 2d, magnets must necessarily have transverse layers of atoms as can be demonstrated by this atomic law, as well as otherwise. Steel when once magnetized remains a permanent magnet because of its transverse polarizations, while the layers of iron are held transversely only when under the electric or magnetic current, consequently its magnetism ceases when the current is withdrawn. See XXX of this chapter.

XVIII.—Laws of Atomic Combination.

1. Atoms must combine to a considerable extent according to the general law of their spirals. Two distinctive styles of atoms seem to be clearly demonstrable in different substances, in one of which the spirals move around almost perpendicular to the direction of the atom, as in fig. 139, while in the other, their movement is more diagonal as in fig. 140. The former would tend to make the atoms broader and capable of more specific heat, while the latter would extend them into a longer and narrower form, with the external spirals more drawn



Fig. 139. Transverse Lines.



Fig. 140. Transverse Diagonals.

out, somewhat as they are in the axial or electrical portion of the atom. The one would doubtless find its type in steel, the other in bismuth or antimony, the specific heat of which is exceedingly small.

2. Figures 139, and 140 will show just why certain substances will have tranverse polarizations, in which the layers of atoms cross each other very nearly at right angles, while others will have transverse diagonals, for the following reasons :—The spirals in 139 running in the direction of 1, 2, form little whirlwinds of force in that direction which, striking a contiguous line of atoms, must tend to wheel it around accordingly and hold it there, especially under excitement, as in 5, 6, while in fig. 140, the lines of force being diagonal, must sweep the atoms around until they become diagonally transverse, as in 5, 6. In most cases, however, it is probable that the line 6, 5, should be reversed with the vortex end at 6 instead of 5, in which case we could easily see how such a phenomenon as double refraction might occur as in Iceland spar, a part of the light striking at 3 and moving on to 4, and another part striking at 6 and moving on to 5.

3. It is evident that when any substance is aroused to extra action by friction or by passing an electrical current through it, a part of the lines will be thrown into a transverse arrangement, or at least into transverse diagonals, according to whether the spirals pass around the atoms, as in fig. 139, or obliquely, as in fig. 140. What proof have we that this is so? We know that if we rub any object briskly, and hold it near a hair or some other light object, it will attract it. The fact of this attraction shows that there are eddies of etherial force which sweep around in and out of the object frictionized, and draw other objects towards itself. But what has this to do with showing that excited objects have their atomic lines arranged transversely? my reader may say. Just this ; if the lines should all run in the same direction, there would be no counter-currents to deflect them so that the neighboring vortexes could draw them in and thus establish a circuit of forces which, like a miniature whirlwind, is attractive to everything around. Thus a piece of iron in its ordinary condition will attract nothing, but pass a current of electricity through it and it immediately becomes magnetic and highly attractive, and this attraction is caused by circuits of

force as shown by iron filings which may be placed above it on a piece of paper. (See fig. 23.) Glass must have its atomic lines polarized in various directions, or it would not be transparent in all these directions, for which reason it is highly attractive when excited, and for which reason, also, glass and other irregularly polarized objects are called non-conductors of electricity as the transverse lines obstruct the electrical ethers. Transverse diagonals, if not arranged somewhat amorphously, must be less obstructive and consequently better conductors of both heat and electricity than transverse lines in which the more perpendicular spirals rule, as in fig. 139. Silver, copper, etc., which are such fine conductors, may be presumed to be more diagonally arranged than steel, which is a poor conductor, comparatively. Good conduction also requires continuous lines of polarity, and all amorphous bodies must necessarily be poor conductors, as well as all bodies which have polarizations in too many directions, like gutta percha, leather, etc. That these last bodies must be polarized in various directions is evident from their toughness in all directions, the greatest cohesion, as we have seen, being in the line of polarity.

XIX. Paraverse Layers of Atoms,

Are those in which the lines are all turned in the same direction, (See fig. 141), the positive spirillæ of one line being arranged against the negative spirillæ of the contiguous line. This should give seemingly a lateral cohesion about the same as that in *converse* lines, though somewhat less perhaps from the less perfect union of graded spirillæ. It throws the second range of atoms a little farther along than the first, the third one still farther on, etc., resulting in diagonally formed and rhomboidal crystallizations, as in bismuth, antimony, quartz, ice, etc. It is probable that this paraverse arrangement of atoms comes from diagonal spirals. It will be seen in the cut how the large, active sub-coils of one atom come opposite to the feebler ones of another so as to promote attrac-

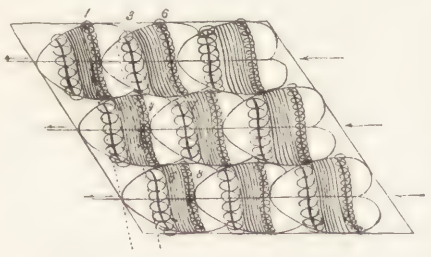


Fig. 141. Paraverse Layers of Atoms.

tion. Thus the positive spirilla 7 binds the negative spirilla 6 and 8 to it, 2 draws 1, 5 draws 4, etc.

XX. Crystalloid and Amorphous Bodies.

Crystalloid and other regulary formed or morphous bodies are such as grow into some definite forms on account of a general and regular polarization of their atoms. *They are capable of strong chemical effects*, and examples of them may be seen in crystallizations, stratified rocks, grained woods, etc. *Amorphous Bodies*, or literally those without form, are deficient in continuous polarities and orderly arrangement of molecules. Clumps of earth, many ores in a crude state, pulverized substances, snow, etc., are amorphous. When the ores are worked up into bars of metal, they generally become more or less crystalloid. No forms whatever are entirely destitute of polar arrangement, but *amorphous bodies have but short or irregular lines of force, and consequently are negative and lacking in chemical effect.*

XXI. Heat and Cold.

1. Heat expands, individualizes, works on the centrifugal law, and in excess tends to disorganize and tear into pieces; Cold contracts, polarizes, organizes, crystallizes, works on the centripetal law, and in excess tends to lifelessness and congelation.

2. The *Law of Motion* for heat is the spiral with its eddies of force passing around the outside of atoms; that for cold is the same combination of eddies narrowed down to a *vortex* which passes in the opposite direction through the axes of atoms, and becomes swifter, narrower, and straighter as it proceeds.

3. The *greatest Heat Lines* are in the greatest *curves*—the *greatest Cold Forces* approximate more and more the *straight line.*

4. *Heat* produces its sting by laying on countless millions of *lashes* every second, and *cold,* by piercing with countless gimlets on the *boring* process.

5. There are various grades of heat and cold, the coarser grades consisting of the coarser ethers passing through the coarser spirillæ. These in excess are more painful and hurtful to the human system, while the finer grades, being connected with the finer spi-

rals, are more penetrating and soft in their influence. (See Chap. First, XV.) We may be pierced by a razor, and it will hurt us far less than will so coarse an instrument as a hoe; a current of electricity may penetrate entirely through a portion of our bodies, and make but a gentle shock from its fineness, while currents of human magnetism, being still more exquisite, may at times permeate the whole system without our consciousness. This will explain the effect of different grades of fineness of heat and cold, and will also show why *sun-light* is less hurtful to the eyes than the coarser *gas-light*, which has more of the yellow and red principle, and why the *color-electricities* of blue and violet, for instance, are so much softer than the electricity of the battery.

6. It may be well to remark that *all the finer grades of cold are simply grades of electricity*, as will be seen hereafter.

7. I will merely hint here at the fact that *the heat and cold principles in atoms form a chemical affinity for each other, which explains why it is that the greatest heat is developed by combining cold and electrical elements with those which are warm, as the blue with red light, or the electrical principle of oxygen with the thermal principle of potassium, by the union of which a flame is kindled.* (See Chromo Chemistry.)

XXII. Atomic Divisions.

1. Before we can understand the philosophy of force we must thoroughly understand the construction of atoms. If any one should remark that no human eye has ever seen an atom, and consequently it cannot be described, I would remark, 1st, that human reason, aided by scientific discovery, can penetrate far beyond telescopes and microscopes; 2dly, I conclude that this atomic theory is fundamentally correct, because it explains multitudes of mysteries not before understood, and harmonizes with or corrects all scientific facts or hypotheses to which I have applied it. If I should apply a key to a hundred doors in some temple, and it should unlock them all, I should say it was the correct key; 3dly, by understanding law we may at times discover a fact or truth by means of reason sooner than we would by outward perceptions without a knowledge of law, just as LeVerrier discovered where the planet Neptune must be from his knowledge of mathematics, before it was discovered by the telescope. I admit

that *we must test theories by facts and facts by theories*, a rule which may be observed with reference even to atoms, and which I have ever aimed to observe.

2. I must again ask the reader to take some of my statements at present on trust or from their apparent reasonableness, promising hereafter in this work, and still further, in a succeeding one, to give facts and reasons. If so much discussion of the subject of atoms is considered dry reading, it should be remembered that we shall be but charlatans in science until we can reach basic principles.

3. We have, then, the atom with its wonderful diversity of powers, including thermal spirals and spirillæ, axial spirals and spirillæ, and the ligo tube, with all the internal and external ethers. I have called the form of the atom an ovoid, but this ovoid is evidently more or less oblate or flattened, 1st, because it would combine more systematically to form layers of matter, and 2dly, because it would readily assume such a form, as the axial spirals, emerging near the small positive end with great velocity of vibratory force, would naturally be swept too far one side to make a complete circular spiral, and so it would assume more of an *oval spiral*, exactly in harmony with the motion of planets around the sun.

4. As to the *extra* or *thermo spirals*, the following are among the arguments in proof that the foregoing conception is founded on nature ; 1st, it is an important dual division of forces in harmony with analogies in general ; 2dly, atoms can be inserted into each other by an exact system in the ordinary polar cohesion and by another exact system in chemical combinations in case certain thermo spirals project beyond the rest, and thus form regular barriers ; 3dly, frictional electricity, especially, is confined to the surface of bodies, and is aroused by external friction or pressure which goes to show that some part of their spirals is external ; 4thly, the fact that frictional electricity is swifter than other grades could be accounted for by supposing its spirals to be the most interior in the axis of atoms where the pathway is shortest and nearest straight. But if its axial spirals are most interior, their thermal portions would naturally be the most exterior ; 5thly Magneto-electricity and magnetism can penetrate considerably below the surface of bodies, which could not be if any part of

the spirals concerned were external, as their action would then be smothered before they had penetrated far within. This shows the necessity of intra-spirals. 6thly, the fact that the electrical colors can penetrate deeply within substances, as in the case of seeds which are reached and germinated by them to a considerable depth below the surface of the soil, shows that no part of their spirals is external, consequently *colors must require intra-spirals.*

5. That there are seven intra spirals in ordinary transparent bodies, six of which constitute the principle of the thermal colors when moving thermally, and that all seven of the same spirals, when moving axially, constitute the principle of the electrical colors, will be more and more evident hereafter. That there are seven intra-spirals of somewhat coarser grade in iron, copper and other opaque bodies, devoted to the manifestation of different grades of heat and electricity, will be shown in this chapter, XXXIII., 2.

XXIII. Cohesion.

1. We have already seen how the *Ligo* rivets the atoms together until they become masses of solid substance, such as metals, rocks, woods, bones, muscles, etc. The suction caused by the ligo ether, together with the firmness of its parts, must cause the principal cohesion, although the other ethers assist to some extent.

2. In such a metal as mercury and in the liquids and gases, the ligo is probably wholly wanting, excepting as some foreign substance may exist in their midst.

3. In case of intense cold the vortical and electrical forces become so swift as to sweep the atoms together into a congealed or solid mass without the aid of the ligo, except as foreign particles may intervene. It should be remembered that *the tendency of cold is not only to diminish the size of all atoms, but to thicken or harden all masses of atoms.* The fact that water, and melted iron, bismuth, zinc and antimony, become somewhat increased in bulk on becoming hardened by cold, does not invalidate the rule, but shows how the process of crystallization can pile some polarized lines upon others in a way to enlarge their size as a mass.

4. When the *heat* becomes very great the spirals of atoms expand to such an extent and become so furious in their centri-

fugal action as to throw even the particles of iron and other metals asunder in a melted condition, in spite of the ligo, and when much greater still, the atoms become so detached as to be wafted off into the air on the swift currents of ether, in the form of vapor. *The tendency of heat is to soften and disintegrate.* If bodies like moist clay become hardened by heat, it is because it evaporates the water and leaves only the atoms which possess the ligo. The small amount of cohesion that exists between the atoms of liquids, gases, and ethers, comes doubtless from the flow of electrical forces through their axes.

XXIV. Different Kinds of Electricity.

My researches in connection with my studies of atomic law have convinced me of the existence of six or more distinct grades of electricity, besides some minor divisions, namely, *Frictional Electricity*, *Chemico Electricity*, *Galvano Electricity*, *Magneto Electricity*, *Chromo Electricity*, and *Psycho Electricity*. The swiftest of these, so far as known, is the *Frictional*, although Chromo-Electricity is much softer and more penetrating. A brief account of these will be in place here. Psycho-Electricity will be explained under the chapter on Chromo-Mentalism.

XXV. Frictional Electricity

Is sometimes improperly called *Static* (standing or stationary), as there is no such thing as any electricity which is not in rapid motion. According to Wheatstone this style of electricity moves at the rate of 288,000 miles a second. For the reason of its swiftness and intense action see XI. 5, of this chapter. Its *element* is electro-ether while its *principle* consists of the axial portion of the thermo-spirals, for the character of which see fig. 135. Being extra spirals in their thermal portion, it will readily be seen why all friction, rubbing, and pressure, will arouse them into action, produce heat as well as electricity. It may be asked why is not frictional electricity, as developed by the electric machine, used for healing purposes? Because it moves almost entirely on the surface of the skin where the nerves of sensation are most active, consequently its effect is exciting rather than soothing or healing. Frictional electricity, as aroused by the hand moving over the surface, is generally very vitalizing and

soothing as it is softened down by the finer vital electricities. Magneto and chromo electricity are finer than the frictional, penetrate more deeply from being connected with intra spirals, and are better for therapeutical purposes. What is called THERMO-ELECTRICITY is often mere frictional electricity, aroused by direct *heat* in connection with the thermo spirals.

XXVI. Chemico Electricity

Seems to be caused by a somewhat coarse ether moving in connection with the axial portion of the coarsest of the intra-spirals (see fig. 22), corresponding probably to the spiral for blue green only coarser. It is doubtless the electricity which is generally called *negative* in its nature, except in galvanism, although the substances which constitute its most natural abiding place from having the right sized spirals, are improperly called *electro positive*, such as potassium, sodium, the metals, etc., while other substances in which frictional, galvano and magneto electricity most naturally dwell are called *electro-negatives*, such as oxygen, sulphur, etc., although these kinds of electricity are strong positive grades as compared with chemico-electricity. To avoid confusion, however, I shall sometimes adopt the terms as scientists have generally established them, begging the reader to remember that what are called electro-positives are substances which are really the most feebly electrical, while those which are called electro-negatives are those which are really the most electro-positive, or, in other words, which are the most strongly electrical. The scientists have fallen into this error from supposing that electricity is a mere dynamical force dwelling entirely within the atoms of a substance, and as dissimilar electricities attract each other, a substance was supposed to be negative in case a positive electricity was evolved from it and vice versa. Under the caption of Galvanism it will be shown how chemico electricity is evolved in connection with the zinc of the battery and moves through the sulphuric or nitric acid to the plate of copper or platinum, while a finer grade of electricity, the galvanic, passes from these latter metals to the zinc. Three things are especially evident with respect to chemico-electricity,—1st, its movement is always attended with more or less heat as well as cold; 2dly, other things being equal, it is the feeblest of all grades of elec-

tricity and the least electrical in its nature, for which reason it is sometimes called *negative* by electricians; 3dly, in galvanism it moves through alternate lines of converse atoms in exactly the opposite direction from galvanic and magnetic electricity. Its movement is attended with heat and a feeble grade of electricity, because, being the last spiral to enter the axis of the atom (see fig. 135), it must necessarily encircle all the rest and have less of that swift narrow and pointed style which constitutes cold and electricity. The causes of its moving in opposite directions will be given under the head of Galvanism, XXXIV.

XXVII.—Galvano-Electricity

Is a grade finer than the chemico, and answers to the axial spirals which correspond to the electro-lumino spirals for the blue, including also indigo-blue and probably indigo, though coarser than these. It is the finer positive electricity which moves in the galvanic circuit from the copper to the zinc, etc., and doubtless exists in many so-called electro-negative substances. How do we know that galvano-electricity is not as fine a grade as that of the blue color? Because if it were it would give out a blue appearance, and moreover its effects are less soft and penetrating than those of blue sunlight. See Galvanism, XXXIV.

XXVIII.—Magneto-Electricity,

A Grade finer than the galvano, and made in connection with spirals that correspond with the electro-lumino-spirals for the violet, including violet-indigo, violet and dark violet. The finest *induced currents* of the battery, sometimes called *Faradaic,* from Faraday, consist of magneto electricity. The positive pole of the magnet gets its power from magneto electricity bent into curves, while the negative or south pole is presumably charged with the chemico-grade. See Magnetism (XXX.) Although the magneto grade is coarser than the color electricities, yet, under the force of the magnet, it is readily driven through glass whose spirals form a natural pathway of light and color. This may be proved by placing iron filings on a pane of glass and holding a magnet below it, in which case the filings will be thrown upward and also into a great number of lateral curves on both sides.

XXIX.—Chromo-Electricity.

We come at last to a grade of electricity whose ethers and spirals are fine enough to appeal to the eye in the form of the electrical colors, such as blue, violet, etc., already mentioned. Although the scientific world has not yet learned that these colors constitute one grade of electricity, yet they have discovered many facts that bear in that direction. I will mention some points in proof :—

1. Electricity, as I have already shown, consists of the cold contracting principle. The violet end of the color scale is known to consist of cold colors, just as the red end is warm, as shown by the thermometer and thermo pile.

2. Morichini, Carpa, Ridolfi, and Mrs. Somerville state that, by exposing common steel needles to the violet rays of a spectrum, or by covering one-half of them with blue glass, they become magnetic. Ampère has shown that magnetism is identical with electricity, and it will be shown hereafter in this work that magnetism consists of electricity thrown into curves by passing in transverse lines. The persons who deny the electrical character of the violet and blue rays present insufficient facts, although the grade of electricity is finer than that which usually influences the galvanometer, or perhaps even the magnet.

3. Zantedeschi exposed a magnet, which would carry 15 ounces, to the sun 3 days, and increased its power two and a half times. Barlocci found that a magnet which would lift one pound, would lift nearly two pounds after exposing to strong sunlight 24 hours. No one will pretend that the red or other thermal colors could have done this, while the facts of the last paragraph show that the violet end of the scale is quite competent to it. The reader may wonder how sunlight can arouse magnetism if, as I have shown, the magnetic ethers are somewhat coarser than chromo-electricity. I shall show hereafter under the head of Fluorescence (XXXIII), and elsewhere, that under stimulus, coarse ethers can sometimes be forced through spirals which are naturally too fine for them, and fine ethers through spirals which are naturally too coarse for them. Although chromo-electricity may stimulate, and to some extent pass through the atomic spirals of a magnet, this stimulus evidently tends to draw in from the

atmosphere magneto-electricity, especially in cold weather, from the fact that if the former electricity were sufficiently abundant, the magnet itself would be bathed in blue and violet colors.

4. Electricity being the principal cause of *phosphorescence*, and these colors having the same power, tends to prove their similarity of character. "Beccaria examined the solar phosphori," says Prof. Hunt, "and ascertained that the violet ray was the most energetic, and the red ray the least so, in exciting phosphorescence in certain bodies. M. Biot and the elder Becquerel have proved that the slightest electrical disturbance is sufficient to produce these phosphorescent effects. May we not then regard the action of the most refrangible rays, namely, the violet, as analagous to that of electrical disturbance? May not electricity itself be but a development of this mysterious solar emanation?" To this question, aided by our knowledge of atoms, we may answer *no*, so far as ordinary electricity is concerned, as ordinary electricity and magnetism are aroused only indirectly by the solar rays.

5. Electricity is the principle of cold, but, by means of chemical action with thermal substances, can develop the greatest heat known; in the same way blue, indigo and violet constitute the cold end of the spectrum, and yet by means of chemical combination with thermal colors can develop greater heat than could be done with the red color alone. I will cite one example merely. General Pleasanton, of Philadelphia, by putting blue glass in among the panes of clear glass so as to bring blue and white light together, caused the thermometer in his grapery to rise to 110°, while on the outside the temperature was only 35° F., or a little above the freezing point. The General supposed that this effect occurred partly by gaining some electrical force from transmission through the glass, but we shall see under Chromo-Chemistry that the blue rays develop this great heat by combining chemically with the thermal rays of the sunlight. Like other styles of electricity the blue and violet colors can develop no heat, excepting in chemical affinity with warm substances, or when bent into magnetic curves.

6. The odylic colors, explained in the chapter on Chromo Dynamics, and developing the finer potencies of things, prove the electrical nature of blue, violet, etc.

7. It will be fully shown hereafter in this work, that there can be no possible style of chemical affinity without combining some style of electricity with the principle of thermism in atoms. If it should be proved that all shades and hues of blue, indigo and violet fill the office of electricity in chemical combinations, would it not be absurd to say they are not electrical? How fully this can be proved will be seen hereafter.

8. Thus do we have the most overwhelming proofs from the construction of atoms, and from actual experiment, of the electrical nature of these colors, including blue-green, blue, indigo-blue, indigo, violet-indigo, violet and dark violet.

XXX.—Magnetism.

1. Having attained to some conception of electricity as a principle and as an element, and the law of its movement through atoms, it would be well to inquire how it is modified to constitute magnetism. We have already seen that the reason why steel constitutes a permanent magnet when once charged with the proper electricities is, that its atoms must be arranged in transverse layers. This is shown by a bar magnet placed under a piece of card-board or glass upon which iron filings are lying, as in fig. 143. These filings will be drawn into concentric curves each side of the magnet, currents of ether sweeping in connected circuits around, through and on both sides of the magnet, sometimes making the filings project a half an inch above the glass, while through the centre in the direction of N. and S. they lie in straight lines. It is easy to see how transverse lines of force, caused by transverse atoms passing at right angles, could deflect each other from a straight line, and being once deflected they could be drawn into a neighboring vortex of a line of atoms in the magnet where, after passing through, they would be deflected again and perhaps return into the same old channels of the magnet to continue their endless circuits.

2. The straight lines through the centre show that some lines of force are constantly gliding through the magnet lengthwise, having its influx at one end, its efflux at the other. Experiments, especially with the odic lights and colors, seem to prove that these lines of force, sweeping in one direction, consist of magneto-electricity which passes in at the south or negative pole and

passes out at the north or positive pole, while sweeping through the centre in the other direction is the weaker chemico-electricity, entering at the positive pole and emerging at the negative. This will at once show why the magnetic needle points north and south, or at least in the magnetic meridian, as the strong electric and magnetic currents which ever pass northward above the equator and southward below the equator, hold it in the direction in which they move, turning the positive end northward in north latitude, and southward in south latitude. And yet these currents of force that have sufficient momentum to turn the needle in their own direction, just as a vane is turned by the wind, or to throw their curves around heavy weights and bind them to the magnet, are named by our scientists *imponderable!* An electro horse-shoe magnet has been made to lift 10,000 pounds by means of these hooks and lines of so called *imponderable* forces, which are really ethers. The curves at the feebler end of the magnet have a predominance of the chemico-electricity, those at the positive end, of magneto-electricity.

3. The reader can now solve the great mystery of why *similar electricities repel, dissimilar ones attract.* When two positive poles are placed together the currents of magneto-electricity dash against each other and find no vortexes of the right size in the opposite pole to draw them on. When the negative poles are joined the chemico-electricity wars upon chemico-electricity in the same way. When positive and negative poles are joined, the magneto-electricity of the positive end rushes outward and is drawn into its own grade of spirals in the negative end, while the chemico-electricity of the negative end passes outward into its own affinitive spirals of the positive end.

4. Fig. 138 shows by the dotted line 6 how a line of magnetism may pass out of the torrent end of one line of atoms and into the vortex end of another line. It is not probable, however, that it would ever pass out and into contiguous lines as represented in the cut, nor in any two lines in the same layer of atoms, as the atomic torrents would be apt to deflect the currents above or below, especially above and northward, as may be supposed from the earth's currents and in a somewhat diagonal direction. That the magnetic currents have this direction may be seen by studying their action on iron filings.

5. Why does not iron, like steel, become permanently magnetic when once charged? Because it needs an electric or magnetic influence to polarize its lines transversely. Above all other substances iron seems to have the right sized spirals for magneto-electricity, although, as Faraday has shown, *nickel, cobalt, manganese, chromium, cerium, titanium, palladium, crown glass, platinum, osmium,* and *oxygen* are more or less magnetic, commencing with the strongest.

6. Why the atmosphere is but slightly magnetic may be accounted for by the fact that the radiations of fine ethers from the sun in the daytime, or from the earth at night, are but slightly transverse, consequently it is diamagnetic.

7. When *glass, sealing wax* and other substances are rubbed they become electrical, and the fact that they will attract hairs, feathers, &c., shows that, for the time being, they are in a condition something like magnetism or at least diamagnetism. Ferromagnetism is by no means the finest or only quality of magnetism, that of light being more exquisite, while the finer grade of human magnetism is so refined as to defy the measurement of the most delicate instruments. Multitudes of examples could be given of persons who possess that psycho-magnetism which enables them to attract and control sensitive persons at a great distance. Sensitives should understand this fact and use their will-power to prevent undue control.

8. "What is the thing that causes magnetic attraction?" says Tyndall. "The human mind has striven long to realize it. * * * The real origin of magnetism is yet to be revealed." The matter seems to be very simple when aided by a knowledge of fluidic and atomic forces. We know how a whirlwind draws in all surrounding objects and holds them fast in its own embrace, and we have seen just how a magnet has millions of minute whirlwinds which sweep into and out of the atomic lines of a magnet and draw a kindred substance like iron to itself. It cannot draw lead or most metals to itself, because their spirillæ are not of the right size to receive magnetic currents.

9. Why is the middle of a magnet devoid of attractive force? The magneto-electricity seems to charge all the spirals and circuits of the positive end towards which it flows as far as it can without escaping into the air, and the same is the case with the

chemico-electricity at the negative end towards which *it* flows. The air being partially non-conducting, hedges in the electricity until it fills some considerable distance from each end, but not enough to reach to the middle.

10. *Great Heat destroys magnetism* by rendering the currents too powerful to be deflected into curves. A magnet must draw in and emit constant streams of electricity from and to the atmosphere. A wire through which a galvanic current is passing becomes for the time being a magnet able to attract iron filings, and causing, by its transverse curves, a magnetic needle to stand at right angles to itself.

11. If we put a magnet under a pane of glass upon which iron filings have been placed, we can at once see that the currents of magneto-electricity throw the filings upward, forward and laterally, thus showing that many of the lines of atoms are polarized in at least three directions. Fig. 143 will show some of the curves and straight lines of force flowing laterally and longitudinally in connexion with a bar magnet, and the lower portion of Plate III will show some of the lines of force which are manifested when the *sides* of the poles of a horse-shoe magnet are placed under the same pane of glass, while the colored flames from each pole, which can be seen by some persons, will show that the north pole has greater power than the south and is manifested by a different array of colors, the significance of which will be explained in the chapter on Chromo Dynamics. The superior attractive power of the north pole is well known and can be tested at any time.

12. I have given thus much attention to magnetism, not only from its great importance and the impossibility of understanding the various potencies of light without it, but because its laws are not understood, and like a hundred other mysteries never can be understood without a knowledge of atoms. The cause of the two directions and two grades of electricity will be shown under the head of Galvanism, in XXXIV of this chapter.

XXXI. Diamagnetism.

1. If an iron nail or other magnetic substance should be suspended from the middle between the poles of a horse-shoe magnet it will immediately arrange itself in the magnetic axis and

point to the north and south pole thus, N—S, but if a piece of bismuth, or phosphorus, or antimony, should be suspended in the same way, it will be arranged equatorially or at right angles to the axis as in fig. 142. Such substances are *diamagnetic*, and they are commonly supposed to repel the magnetic currents. This, as I have learned, is a mistake and they assume that position because the diamagnetic axis crosses these substances laterally instead of longitudinally, as is done in the case of magnetic substances: thus the following represents a diamagnetic substance between the magnetic poles:—

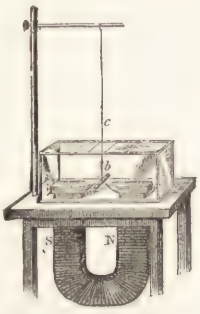


Fig. 142. Horse-Shoe Magnet.

Magneto-electricity flowing from the positive pole of the magnet, through the substance laterally and into the negative pole of the magnet.

N—→|←—S

Chemico-electricity flowing from the negative pole of the magnet in opposite direction into the positive or north pole of magnet.

The following represents the axis of a magnetic substance:—

Magneto-electricity flowing from positive pole of magnet through the substance longtitudinally and entering the positive pole of magnet.

N—→ S. N. ←—S

Chemico-electricity flowing from negative pole of magnet in opposite direction and entering the positive pole of magnet.

2. A little better conception of the distinctions which seem to arrange all substances under two divisions, the *magnetic* and *diamagnetic*, may be obtained by considering figs. 143 and 144. Fig. 143 shows a bar of steel, S N, which has been converted

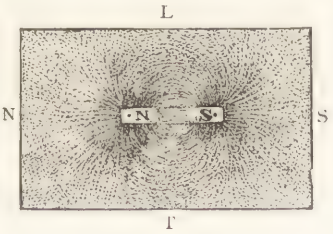


Fig. 143. Magnetic lines as shown by iron filings.

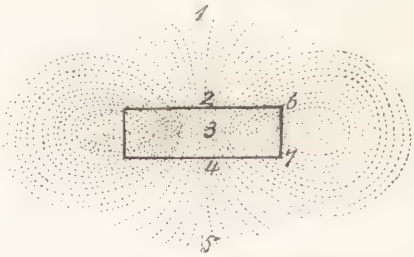


Fig. 144. Supposed Diamagnetic lines of Force.

into a magnet, N being the north or positive pole, and S the south or negative pole. When a pane of glass or a piece of card-board, sprinkled with iron filings, is laid upon this bar, the filings will be arranged as shown in the cut, and some will also be thrown upward in a bristling attitude which cannot be shown here. It will readily be perceived from the lines running longitud-

inally that there must be polarized lines of atoms running conversely from S to N, and from the curves which sweep directly across the bar that there must be transverse lines in the direction of T, L and L, T. The many curves of force which must sweep in and out at the ends do not appear distinctly. It will be seen that the longitudinal lines are sufficiently strong to prevent the transverse forces from passing at a point midway between the poles where the magnet is weakest, although *consequent points* of special power are sometimes formed between the poles where the forces break through, especially in a long magnet.

3. In fig. 144, illustrating what is probably the pathway of forces in one kind of diamagnetism, if not in all, the arrangement of atoms is quite different, being on the law of transverse diagonals, some modification of which is no doubt the universal law in diamagnetism, just as lines directly transverse or nearly so, are required for magnetism. Before going further the reader should be familiar with the combination of atoms as described in previous figures, especially 139 and 140. In fig. 144 we will suppose a diamagnetic substance 3 has diagonal polarizations in the direction of 2, 7, and 4, 6, or still more diagonally. When the electro ethers are radiated powerfully by means of electrical or magnetic excitement into two or more general directions, diagonally transverse, those passing through the atmosphere in one direction must create currents which will deflect some of the lines passing in the other direction sufficiently inward to cause them to be drawn in by the vortical suction, and thus lines of force would be formed as in the figure. In such transverse diagonals, there being no longitudinal lines, a passage way is naturally easily forced through the shorter pathway from side to side, whereas it must be a difficult matter to force it lengthwise.

4. In speaking of magneto and chemico electricity as passing through diamagnetic substances, I simply mean that they do so under the pressure of magnetic excitement. It is reasonable to suppose, however, that the ethers which usually course through diamagnetic substances differ from each other in different bodies and especially from ferro-magnetism. It has been found that a powerful magnet will either attract or repel all substances. Those substances which are spoken of as being repelled by it are doubtless simply diamagnetic.

5. We learn then, that *while a magnetic substance consists of converse lines of atoms which cross each other at right angles, or nearly so, the lines of a diamagnetic substance cross each other diagonally, or consist of transverse diagonals.* These diagonals may be the natural arrangement of atoms in a diamagnetic substance, or may be polarized into this shape by the power of light or electricity. Diamagnets have a very much feebler attractive power than magnets, as comparatively few of their lines are bent into curves. The flame of a candle as well as electric light has been found to be diamagnetic, and the sunlight coming to us in convergent and divergent rays and polarizing the atmosphere accordingly, must impart more of the diamagnetic than the magnetic style of influence, as electricians have ascertained. The names of some of the diamagnetic substances as ascertained by Faraday, commencing with the most decided, are *bismuth, phosphorus, antimony, zinc, tin, cadmium, sodium, flint-glass, mercury, lead, silver, copper, water, gold, alcohol, ether, arsenic, uranium, rhodium, iridium, tungsten, nitrogen, etc.* Faraday says that man as a whole is diamagnetic. This is doubtless true, the right side being positive, the left negative, all the way from the head to the feet, as will be shown hereafter. The living human form may also be called a series of magnets.

XXXII. Phosphorescence.

1. "The sulphur compounds of calcium, strontium and barium (which should be kept in hermetically sealed glass tubes) do not exhibit the faintest light in a dark room. Moreover, if they be covered with a yellow glass and illuminated with the light of a magnesium lamp, they remain as dark as before. But if the yellow be exchanged for a blue glass, and the magnesium light be allowed to play upon them for a few seconds only, they emit in the dark a soft light, each powder having its own proper tint of color." (Prof. Eugene Lommel's Light and Color.) This power of shining in the dark is termed *phosphorescence*, and as in the above case it is developed by the electrical blue, so in all cases must some principle of electricity be used in its production. The electrical principle strikes some sensitive substance for which it has a chemical affiinity, and creates such activity of atomic action as to render it partly incandescent.

2. "Mademoiselle Linnæus" says Pouchet, "first discovered that the *monkshood* sent out passing gleams of light which were generally attributed to electricity."

3. In *phosphorus, touchwood, fireflies* and different kinds of *marine animals,* the light is awakened by certain physiological as well as chemical processes in which electricity and heat are combined. The gentle style of combustion which constitutes phosphorescence, seems to be attended with so fine a grade of heat as to be imperceptible as heat to most persons.

4. Several substances may be exposed to brilliant light like that of the sun or a magnesium light, and on darkening the room will continue to glow for hours, emitting the red, blue, green, etc., according to the nature of the substances. Alumina, when phosphorescent, emits a red light ; diamond, from its refrangibility, emits most of the colors. Phosphate of lime, fluor spar, etc., phosphoresce with different colors. Metals, liquids, &c., do not phosphoresce from the power of light.

XXXIII. Fluorescence, Calorescence and Kindred Principles.

1. This is a proper place to show how nearly the ethers, and the spirals through which they pass, must correspond in grade with each other. In music, a stretched cord or a tuning fork will respond to vibrations of the air which synchronize with their own, so in atoms, as we have already seen, each spiral cord must vibrate to and invite onward that grade of ether whose waves are simultaneous with its own movements. Thus the red forming spiral naturally invites a certain grade of ether ; the blue, being finer and more frequent of movement, invites a finer ether, while the violet and the space above the violet invite still finer ones. What I wish to state here is, that although this is the general law, yet under the stimulus of electricity, or light, or heat, or chemical action, a grade of ether may at times be forced through spirals naturally too fine for it, and at other times through spirals not fine enough for it. Take glass for instance. Its spirals being of the grade suited to the ethers which go to make light, are too fine to admit the ethers of frictional or galvanic electricity at any ordinary pressure, consequently glass is used as an insulator to prevent their passage. If we charge a bar of metal strongly

with electricity, however, and place a pane of glass near one end where the electrical tension is great, another bar of metal held on the other side will become charged by induction through the glass. In the same way, the electrical currents of a magnet are so powerful as readily to sweep through glass in all directions, as may be seen by placing iron filings on the upper side of glass and a magnet below. It is evident that all ordinary grades of electricity must become somewhat refined by being strained through glass.

2. *Calorescence.* Again, take an opaque metal, such as iron or copper for instance. This has its seven intra spirals, as facts go to show, corresponding with the color spirals and yet of a coarser grade. If they were of as fine a grade as the color spirals they would transmit all the colors in their natural state just as glass or water or the asmosphere does, and hence be transparent. As the metal becomes heated its atoms expand with violent motion, and its ethers are absorbed and transmitted with power. When heated to 700° F. it begins to emit a dull red color in the dark. Why is this? The following seems to be the answer:—The thermo spirals which are the first to respond to heat, being put into violent motion, agitate the thermel and red of the iron, or rather the spirals corresponding to the thermel and red, into such a violent whirl as to draw on and propel to the eye not only the ethers which naturally answer to it, but a certain amount of a still finer ether which constitutes the element of red. This transmutation of power under extreme action is common in nature. So fine a substance as the air when in violent motion, may carry so coarse a substance as water into the sky, and this coarse element of water may be made to move so rapidly, as to sweep a current of air along with it. Even a cannon ball will at times kill a man without touching him, simply by the terrific atmospheric forces which it arouses. So, reasoning from the known to the unknown, we see how a coarser current in violent action may draw on or propel a little finer current of a color-ether. As the heat rises to 1000° F. the red-orange spiral, which is contiguous to the red, becomes sufficiently agitated to put into play the red-orange ethers and thus the iron appears red-orange. When reaching 1100°, the spiral answering to yellow is reached, and so the metal is said to be at a *yellow heat;* when the heat ranges from 1400° to 3280°, a sufficient amount of the green and blue-green has

been reached to form, when combined with the lower colors, white, consequently the iron is said to be at a *white heat.* When still hotter, the blue and indigo become so intense as to predominate and cause a *blue heat.* This shows three things, 1st, that ethers can be propelled by spirillæ which are naturally too coarse for them ; 2dly, that iron and other metals have the same number and general system of gradation in their intra-spirals as have the color spirals of transparent substances ; 3dly, that in circumstances of great activity, a coarser spirilla may work with a color ether somewhat too fine for it, and not very much pervert the color itself. It is true that what we call *red hot* is not a pure red as compared with carmine and the other colors thus caused, though luminous, are not absolutely pure, but are a close approach to it and become the more pure by being strained through the color spirillæ of the asmosphere which are of the right grade. This development of colors in metals and other bodies by different grades of heat is well called CALORESCENCE by Tyndall.

3. On the other hand white light may be transferred into the coarser spirals of a black substance and transform its color forces into heat, through the attractive power of chemical affinity.

4. The invisible portion of the solar spectrum above the violet is sometimes called *ultra violet,* which means *extreme* violet. But we have seen that this portion is not violet at all, but rather a finer grade of reddish color towards which the violet progresses and consequently such a term as *trans-violet* (*beyond the violet*) would seem more proper. The invisible portion below the red is not properly *ultra* or extreme red, as it is sometimes called, but rather the *trans-red* (*beyond the red*), the beginning of which is the *thermel.*

5. The *trans-violet* may suddenly be made visible in the form of blue and sometimes lavender if its rays are made to pass through fluor spar, or a decoction of the bark of horse-chestnut, or a solution of sulphate of quinine, etc. This is an example of fine ethers being drawn on into spirillæ which are naturally too coarse for them, by means of the chemical affinity which these substances have for them, and is called FLUORESCENCE, from *fluor spar.* Fluorescence, then, is caused by straining the trans-violet colors which are too fine to be seen, through spirillæ, whose movements are sufficiently slow to affect the vision. The pro-

cess of lowering a color to a coarser grade is sometimes called the *degradation of light.*

6. We may thus see how several mysteries are cleared up by this department of the etherio-atomic law, and new light thrown upon the *convertibility of forces.*

XXXIV.—GALVANISM.*

1. Galvanism is electricity which is developed by chemical action, just as frictional electricity is developed by mechanical and thermal action. The one may be artificially developed by aid of what is called the battery, usually supplied with acidulated water and two heterogeneous metals; the other, by means of the *electrical machine,* which is supplied with a glass plate or cylinder. This is revolved against some frictionizing substance, such as gutta percha or leather, which contains a more negative quality of electricity. Galvanism develops chemico-electricity, galvano-electricity, and to some extent magneto-electricity.

2. Water, as can be shown, naturally winds up into ball-coils whose threads are polarized lines of atoms composed of hydrogen and oxygen. Hydrogen, which has an immense thermal action of its atoms, far greater than that of any other known substance, tends to draw the other atoms around to itself, and thus the winding process is commenced. *Drops of water are spherical ball-coils. Acids are highly electrical* and abound in chemico as well as other kinds of electricity. One part of sulphuric acid to 8, 10, or 12 parts of soft water is generally used, though other acids and substances are frequently employed.

3. This powerful acid thus combined has its thermal and axial forces especially aroused and immediately unwinds and straightens out by its swift forces, the polarized lines of water, loosening the cohesion of its own atoms of oxygen and hydrogen, and probably arranging them conversely with those of that fluid according to a necessity which we have already seen. Two metals of diverse character are placed in this liquid, one of which, as zinc for instance, must have a much greater affinity for oxygen than the other, which is usually copper or platinum. In fig. 145,

* From Galvani, who first discovered it, although Volta made such improvements in it that it is often called *Voltaic Electricity*

Z is the zinc plate, and C the copper plate, set into the diluted sulphuric acid, and connected at the top with a wire. No. 1 shows a polarized line of molecules of water; No. 2 consists of a contiguous line of the molecules of sulphuric acid polarized in the opposite direction. The galvano, and doubtless the magneto electric current, sweeps through the line of water No. 1, enters the zinc, passes up and around through the wire and through the copper plate back into the zinc again, and so continues as before. The chemico, and perhaps some other electric currents, under the active movement of the sulphuric acid, pass through line No. 2 from the zinc to the copper and then around through the wire back into the zinc and acid again.

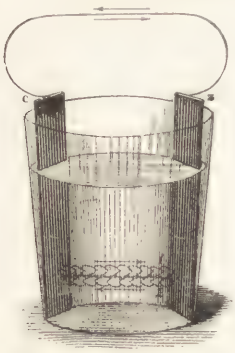


Fig. 145. A Galvanic Battery.

What gives the starting impulse of these great forces? In the first place, in the polarized lines of water, the atoms of oxygen nearest the zinc rendered intensely active by the presence of sulphuric acid, are both swept and drawn by affinitive currents into the vortexes of the zinc, and consequently are torn away from their affinitive atoms of hydrogen. These atoms of hydrogen thus set free seize upon the atoms of oxygen of the contiguous molecules, and thus *their* atoms of hydrogen become free. This second set of freed hydrogen atoms seizes the third set of oxygen atoms, and so the process goes on until all the molecules leading to the plate of copper have thus been readjusted. When the last molecule contiguous to the copper has been reached, the freed particles of hydrogen finding no oxygen to combine with, rise to the top of the liquid and emerge into the air in small bubbles. The vortex end of this line of atoms with suction made especially powerful by such an active chemical readjustment, draws on the affinitive currents from the copper itself, and this again from the wire, and the wire from the upper portion of the zinc until original currents through the water have again been reached, and so the current is rendered continuous as long as the wire joins the plates and the chemical action is kept up. The atoms of oxygen which are first driven and drawn into the vortexes of the zinc in connection with the sulphuric acid, loosen and sepa-

rate these contiguous atoms of zinc which encase them from the original metal, and fall into the liquid as the *sulphate of zinc*, there to be dissolved. This leaves the atoms of zinc exposed for the next set of atoms of oxygen, which rush in and cause another redjustment all the way to the copper. This process is continued until the zinc is eaten away, or the acid exhausted of its power.

4. "If the zinc, after being thoroughly cleansed by immersion in the acidulated water, be rubbed with mercury, it immediately acquires a bright amalgamated surface, and when restored to the water it no longer exerts any decomposing action, and particles of hydrogen are no longer seen to rise from it. The instant, however, that a connection is made by a wire or otherwise, with the conducting plate, hydrogen bubbles at once begin to be discharged from it as before. The cause of this is not understood, but constant use is made of the fact to protect the zinc plates from corrosion, except during the period when the battery is actually in action." (Pynchon's "Chemical Forces.")

5. The above mystery is readily solved by the principles already illustrated in paragraph XXXIII. The mercury which forms the amalgam of the zinc evidently has spirals too fine to be penetrated by the currents which ordinarily draw the oxygen up to the zinc, but when the circuit is made complete by uniting the wires, the electro motive force becomes sufficiently powerful to drive them through.

6. Electricians, being unacquainted with the laws of atomic action, commonly suppose that the leading electric current must move from the zinc to the copper because chemical action is in that direction, but the error of this is easily seen. The chemico-electric current which flows through the sulphuric acid passes in that direction, but it is really less penetrating than the other, although its ruder style of power may produce a more immediate effect. *It moves in a direction opposite to that of the water because the atoms are polarized conversely to those of that fluid.* The reasons for saying the chemico electricity circulates through the acid will also be given in the paragraph XXXVI. The fact that the chemico electricity may in galvanism become a seemingly positive current, stronger in electrolysis than even the currents in the opposite direction, shows that a grade of electricity, naturally weak, can be made powerful by an intense acid. In the magnet, however, its weakness is more evident.

XXXV.—Why does Frictional Electricity move mainly in one Direction?

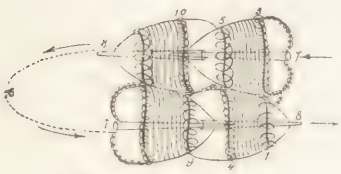


Fig. 146. Atomic Forces.

1. We will suppose that in fig. 146, a rubber of an electrical machine should be passed over the atoms from right to left. The motion being in the same direction as the spirillæ of the lower line of atoms, 1, 4, 9, would intensify their motion. On the upper line of atoms, however, the spirillæ being in the opposite direction would be impeded in their action. The negative eddy 3, would be robbed of a portion of its ethers by the positive eddy 1, and by the time it should pass axially from 7 to 8 its principle of electricity would be very feeble. A movement from left to right would set the upper spirals into active movement and impede the lower. A movement from 3 to 1 would have the same effect. A movement from 1 to 3, would arouse the lower spirals and deaden the upper, so that in whatever way the friction is directed, only the alternate spirals, which move in one direction, are appreciably affected by any ordinary action, in any one part of a substance. The common supposition that there are two kinds of electricity moving in opposite directions in frictionized substances, would seem, then, to be an error.

2. *Magnetism* has its bipolar conditions and its different electricities moving in opposite directions, but these are accounted for on the same principle as the same thing in galvanism, magnetism usually being generated through the aid of galvanism. The loadstone or natural magnet, composed of the oxide of iron, probably owes its dual polarity to liquids and elements of the soil which act on the galvanic principle.

XXXVI. Positive and Negative Electricities.

1. It is now time to attack this great mystery and see what light can be afforded by the etherio-atomic law. "Notwithstanding the great importance of the numerous electrical phenomena, we are still ignorant of their cause," says Ganot. Chambers's Encyclopedia admits that the terms *positive* and *negative*, as

generally used, are "meaningless," but are adopted for convenience. Certain substances, when rubbed or beaten, send forth more positive electrical effect than others. Thus frictionized glass produces a decided action and is said to have *positive* or + electricity, while frictionized gutta percha, shellac or resin, being feebler, are said to have *negative* or — electricity. *Why should one substance thus have stronger currents than another? One great cause of electrical power in bodies is their superior polarization, as the others must sweep with much greater force through unbroken lines than they would through amorphous bodies, or those in which short or confused lines prevail. But why should some bodies possess this finer polarization and crystallization? Evidently because they have spirals which invite the finer and swifter electricities that are so powerful as to straighten out the atoms into continuous lines.* Take the two substances, glass and shellac, for instance. Shellac is evidently more amorphous than glass, from having coarser and weaker electricities. Glass, as we have seen, must have spirillæ adapted to the electro-lumino as well as the magneto ethers, and capable of thorough polarization from its power to transmit light. Shellac has no spirillæ fine enough to admit light, and very probably has the chemico-electricity as its prominent force, which would account for its different and weaker character. But frictional electricity, it may be said, does not deal with these more interior electricities. Not so directly, I admit, although powerful frictionizing machines have developed even galvano and magneto electricities by reaction, no doubt, upon the intra-spirals. It is evident, however, that if glass has longer lines of polarization than shellac, its frictional electricity must be more positive than the same electricity of that substance.

2. But another principle must be considered. Metals doubtless have quite as long lines of polarization as glass or silk. Why, then, will they not produce the attractive and electrical effect when rubbed that these substances do? Because they are such good conductors that their electricity escapes. Glass, silk, flannel, etc., have a sufficiency of transverse lines to deflect a portion of their currents into curves somewhat like the magnetic, which accounts for their power to attract light substances, such as hairs, feathers, etc., and also for their poor conduction. Unlike the

magnet, however, we can scarcely say that there are two electricities moving in opposite directions in such substances as they are not bipolar.

3. "The electricity developed on a body," says Ganot, "depends on the body rubbed. Thus glass becomes negatively electrified when rubbed with catskin, but positively when rubbed with silk." In the following list, the substances are arranged in such an order, that each becomes positively electrified when rubbed with any of the bodies following, but negatively when rubbed with any of those which precede it: 1 *catskin;* 2, *flannel;* 3, *glass;* 4, *silk;* 5, *the hand;* 6, *wood;* 7, *metals;* 8, *caoutchouc (India Rubber);* 9 *resin;* 10, *sulphur;* 11, *gutta percha;* 12, *gun cotton.* The ordinary supposition that each substance can develop two different kinds of electricities in other substances is unnecessary and unnatural. (See P. XXXV.) The following seems to be an easy solution of the difficulty: glass becomes negative when rubbed with catskin because its currents are overpowered and driven *inward* by the stronger currents of the latter. It becomes positive when rubbed with silk because its currents are strong enough to drive inward those of that substance. The same principle holds with the other substances. The metals may naturally have swifter styles of electricity than catskin or silk, but these latter, by their curved and transverse lines, can hold the electricity until its tension is sufficient to overpower even the metals. *A negative body, or part of a body, is that in which the influx electricities preponderate over the efflux, while a positive body or part of a body, is that in which the efflux electricities preponderate over the influx.* It is easy to see, then, why positive and negative conditions of electricity attract each other, as the influx or vortical currents of the latter attract the torrents of the former, and it is also plain that two positives must repel because their torrents dash against each other, or that two negatives must also be inharmonious as they draw in opposite directions. The law is that *contrasting electricities attract, similar electricities repel.*

4 Why one end of a magnet is more positive than the other, as we have already seen, comes from the fact of a more interior and potent electricity. Fogs, snow and rain are nearly always charged with a positive grade of electricity, and clouds quite fre-

quently are. The earth is negative in the daytime to the atmospheric electricities, which, under the polarizing power and stimulus of the sunlight, are radiated into its surface, while in the night it becomes positive to the atmosphere, radiating its electric currents upward and outward. A thunder-cloud with its transverse and irregular lines, is capable of holding the electricity in curves around its surface until a large amount is collected and the electrical tension becomes very great. Suppose, now, that this cloud, so strongly or *positively* charged, should approach another cloud less charged. The vortical attractions of this feebler cloud will cause this mass of electricity to burst the barriers of the non-conducting atmosphere and dash into its neighbor with an explosive and frictional force which gives the effect of lightning and thunder. The clouds are relatively + and — in their electrical condition. When a positive cloud approaches the earth, which is negative, the electricity passes into the earth. When a negatively charged cloud approaches the earth, however, we sometimes have the *ascending lightning*, the electricity passing from the earth to the cloud.

XXXVII CHEMICAL AFFINITY.

1. This great mystery of chemical affinity which has so long puzzled the chemists, becomes comparatively simple by understanding the working of ethers and atoms. The reader, who has not become familiar with the matter already explained, should go back and study the form and working of atoms, together with the *etherial winds of force* which sweep them together, or drive them asunder. Chemical affinity results principally from the two following laws:

2. *The leading cause of chemical affinity appears in the fact that atoms of one kind, having a strong thermal and vortical action, become thus expanded so as to receive far within themselves atoms of another kind which are drawn in narrower by means of their strong axial or electrical action.*

3. *There must be a similarity in the character and size of some of the leading spirillæ of the combining atoms so that the same ethers may glide unimpeded through the whole to bind them together by a common propulsion and suction.* The first of the above

rules gives the law of diversity, the second the law of unity in chemical combination.

4. It is easy to see how the wide mouthed heat-atom, with its powerful vortical forces, can draw the narrower cold producing atom into itself, while on the other hand, the powerful axial forces from behind drive the narrower electrical atom into the wide one. It is easy to see, also, how such a powerful affinitive action can drive the one atom into the other all the way up to the ridge formed by the widest thermo spirals which are near the vortex, as represented in fig. 147, while ordinary cohesion is not strong enough to drive the atom into the encasing one farther than to the first or positive thermo spirals, as seen in figs. 136 and 137, which are non-chemical. But why do I know that the basic atom in chemical affinity encases the other up to these larger thermo spirals? Because, first, I know that chemical union is closer than that of ordinary cohesion, consequently it must sink the atoms deeper than to the smaller or positive thermo spirals. Having surmounted these there will be no barrier until the larger spirals are reached; and, secondly, chemical affinity hides the color spirals of the encased atom. Thus carbon is a black substance, while potassium and sodium are white. According to the 2d rule, what should their color be when combined chemically into carbonate of potassa, and carbonate of soda—that of the black carbon, or that of the white potassium and sodium? It should be that of the encasing atom, and the encasing or thermal atoms here must be the potassium and sodium which are electro-positive, as will be shown hereafter, while the carbon, being more electrical, must have its atoms encased and thus have their color spirals hidden by the white of the potassium, etc. In the same way common salt, which is formed of chlorine and sodium, shows only the white color of the latter, the atoms of which entirely swallow up the greenish yellow color of the former. See Chromo-Chemistry for further illustrations.

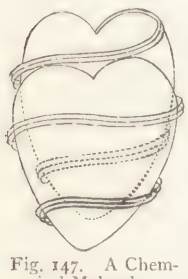


Fig. 147. A Chemical Molecule.

5. It is important to dwell a moment on the causes which give to atoms these dual styles of form by which they are enabled to be combined so beautifully and powerfully. Fig. 148

shows the encasing atom made broad by its thermal activity. The figure represents two types of atoms, one represented by the dotted line, of which potassium is a good example, and the other shown by the main line, of which hydrogen is a good example. Hydrogen, having more specific heat than any other substance must have the broadest atoms, taken all in all, and yet potassium, with far less specific heat, can outdo the hydrogen as shown in its power to tear the atoms of oxygen away from it when thrown into water for instance. How is this? Hydrogen, which is distinguished for its delicacy of action, doubtless has an abundance of fine spirillæ which quickly kindle into action the main spiral, and this commences to lessen before it gets so near the negative end. The potassium has doubtless much coarser spirillæ and corresponding coarse ethers, among which the chemico is doubtless prominent, and working more slowly does not attain its maximum power until the vortex is nearly reached. This gives it a powerful vortex and hence great attractive force. Hydrogen, having an immense amount of heat, has very probably more than three thermo spirals. Its chemical action is fine and powerful, but if its intensity of movement were to be transferred to the vortex it would be terrific and kindle into flame every time a chemical union with other atoms should occur. As it is, it is a great leading developer of heat and light. Sodium, magnesium and other alkaline and electro-positive elements belong to this general style of atom, ranking between the extremes of the hydrogen and potassium. This includes most of the metals whose thermal spirals and ethers are sufficiently coarse and slow of action not to gain their full power until the vortex is approximated, so that they become wide mouthed and especially attractive to the other style of atoms.

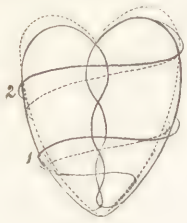


Fig. 148. Thermal or Encasing Atom.

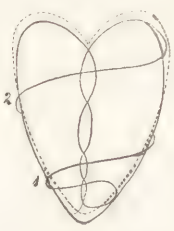


Fig. 149. Electrical Atom.

6. Fig. 149 presents the more narrow and electrical style, in which the axial activities are more potent than the thermal, and in which even the thermal spirals are probably more oblique than in the broader atoms as shown in the diagram. It includes such

atoms as those of the oxygen, sulphur, chlorine, and the other electro-negative substances. This grade of atoms, among which the oxygen is foremost, is prominent in acids in which electricity rules, although hydrogen intensifies the same. The dotted line shows an atom of this grade whose vortex is somewhat expanded and its positive end drawn in small. This is a good type of an atom of oxygen, whose pointed end being small by being the most electrical of atoms, makes it especially suited to penetrate other substances and oxydize them.* More than that its vortex is sufficiently large and active to attract other atoms into itself, and this diversity in its two poles is a great leading cause of its being able to combine with all other elements excepting fluorine. Another reason why it can combine thus universally is that it must have a diversity of spirillæ by means of which it is supplied with those ethers that work harmoniously with the atoms of other substances and drive them together. It is known to be the most *electro-negative* of substances, which is a term that signifies it is the most electrical. Faraday has shown its magnetic character which proves that it has magneto-electricity. Its wide vortex and the fact that it affinitizes with metals and so many substances in which chemico-electricity must exist, argue that chemico ether is one of its forces. As a gas or liquid in air and water, it transmits light, being transparent, which shows that the color electricities may pass through it. Thus does oxygen have affinitive spirals, which are able to receive more or less well the thermo, chemico, thermo-lumino, electro, electro-lumino, galvano and magnetic ethers which, with the form resulting from connection with them, makes it on the whole the most powerful known agent of chemical action, and constituting, according to Dr. Attfield, about half of the substance of the globe. Gold, silver and platinum, and a few other bodies, have but feeble affinities for oxygen excepting when the added electricities of sulphur are brought into action, consequently they maintain their brightness under all ordinary circumstances.

7. The thermo spiral at 2, in fig 149, shows how far the atom generally sinks into the encasing atom in *chemical combinations*, while that at 1 shows how far it sinks in cases of ordinary cohe-

* When metals are oxidized they are said to be covered with rust, which is simply a chemical deposit of oxygen.

sion or mere mixtures, as in the oxygen and nitrogen which constitute *air*, as well as in other substances. In chemical affinity, however, in which there is an alternation of both the narrow and broad atoms, it is not probable that the broader atom sinks into the narrower as far as the narrower sinks into the broader in many cases. Thus in common salt there is an alternation of sodium as the broad mouthed, and chlorine as the narrow-pointed atom, forming when combined what is called a molecule of salt. The chlorine sinks far down into the sodium and hides its color. When the next molecule is joined to this, the broader sodium atom has to be inserted into that of the chlorine, but it evidently does not become encased in it farther than the first or positive thermo spiral at 1, because if it entered as far as 2, its color-spirals would be covered up and it would no longer appear white. It is quite probable, however, that in the case of sulphuric acid (H_2SO_4), and some similar combinations in which the forces move with tremendous power, all the atoms are driven into each other up to their *shoulders*, in other words to number 2, and such may be the case with water, which is really the most powerful solvent, taking it all in all, to be found in nature. Closely as the atoms are driven together in sulphuric acid and water, they become three per cent. smaller still when these substances are combined equally, thus showing that the electrical forces are made even more powerful by their union.

8. Acids are substances in which the *electrical forces* predominate, as I have already remarked, oxygen, or some other electrical element, being the acidifying principle, while hydrogen, also a common ingredient of acids, although possessing a predominant thermism, must yet be highly stimulating to the electrical forces. For proof of the cold, electrical nature of acids, see the chapter on Chromo Chemistry, XVII, 6, 7, 8.

9. Alkalies, the contrast of acids, belong to the *thermal* side of the question, and are included among electro-positives and broad mouthed atoms. As the result of this they must be expansive and relaxing in their general character. This is verified in our medical books, which prescribe as their principle laxatives and purgatives substances which have alkaline bases such as magnesia, sulphate of potassium, sulphate of magnesium (Epsom salts), tartrate of potassium and sodium (Rochelle salts), etc.

Citrate of magnesia, Vichy water and some other alkaline drinks are called cooling, but this can come only from their reactionary effect, or from the electrical principle with which they are combined.

It is perfectly clear, then, why acids and alkalies have such an affinity for each other, as they include the dual conditions of narrow and broad forms, &c.

10. COLOR AFFINITIES may be merely mentioned here. In the chapter on Chromo-Chemistry this whole subject will be developed much more minutely. The reader has already seen that the colors on what is sometimes called the *warm* end of the spectrum, including red, red-orange, orange, yellow-orange, yellow and yellow-green, are made in connection with the spirillæ of the thermal or widening portion of atoms, while the cold colors, blue-green, blue, indigo-blue, indigo, violet-indigo, violet, and dark violet, are made in connection with the spirillæ of the axial or contracting portion of atoms. It is evident at once, then, that substances in which the thermal colors predominate must affinitize with those in which the electrical colors rule. But what is the exact affinity of each color? Let us take the blue-green for instance. The very spiral, or more exactly the spirilla which works as the blue green principle in the axis of an atom, works as the principle of thermel on the outside (See fig. 135). Is it not evident, then, that when the thermel is swept by strong ethers the vibration extends to the inner blue-green portion and vice versa? Again the axial spirilla for blue is simply the inner portion of the thermal spirilla for red. When the blue part is quickened the red part responds by reaction, or when the red part is quickened the blue part responds by direct action. Is it not plain, then, that a broad atom in which red rules would naturally draw into its vortex the narrower electrical atom in which blue rules, especially as the inner portion of each has a leading spirilla of exactly the same size and responding to the same ethers, while both thermal and axial forces must quicken each other? On the same principle, then, the following are the affinitive colors:

Thermel (invisible),	affinitizes with	Blue-Green.
Red	"	Blue.
Red-Orange	"	Indigo-Blue.

Orange	affinitizes with	Indigo.
Yellow-Orange	"	Violet-Indigo.
Yellow	"	Violet.
Yellow-Green	"	Dark-Violet.

For abundant facts in proof that these are affinitive colors, see Chromo-Chemistry (XX), and Chromo-Dynamics.

XXXVIII. Are Atoms Animals?

We have already seen that atoms constitute the most wonderful of *machines*. Has the reader noticed, also, that they are formed almost like an animal? On their outside we have the large and small arteries in the shape of the 1st, 2d, and 3d spirillæ within which the etherial blood flows, and the tubing which constitutes the frame work of these spirillæ, wherein dwell the still finer ethers that may be called their nerve force. The axial spirillæ passing in the other direction on the law of electricity constitute the *veins*. Does the reader notice the remarkable analogy to the human system? Do not the arteries carry the warm red blood in one direction, while the veins carry the more electrical purple blood in the other? We have the ligo as the spine, the tubing of the main spiral as the bowels, that of the spirillæ as the nerves, the vortex as the point of ingress, the torrent as the point of egress, the channels laid out by the external spirillæ as the arteries, those by the axial spirillæ as the veins, while the ethers constitute the blood and nervous aura. And yet a single atom can never constitute a living animal. Different atoms must be combined on the law of chemical affinity before we can presume to have that swift flow of force which helps to inaugurate life. The space is too limited here to show how lines of active atoms may, under the stimulus of a certain amount of heat, be wound up into spirals, spiral balls, tubes, etc., in a way to constitute the *static life* of vegetable growths or the *locomotive life* of animal existences. Hints could be given of how organized *vegetable life* developed in connection with the soil could establish a flow of fine ethers and gases constituting its vitality, and then how a neighboring organization of finer atoms might eventually draw off these ethers and life forces of the vegetable into itself and succeed in reaching a grade of being sufficiently active to exist a brief time aside from the soil which

would thus constitute *animal life*, and again how this animal life might give up its fine forces to some organization a little higher still, and so on until this everlasting progression and evolution from lower to higher conditions, working through countless ages, has attained to the present marvelous developments of vegetable, animal and human life. Is it atheistic to speak of this sublime law of nature because it is seemingly self-acting? By no means, for as we have seen (X) there must be some infinite spiritualizing Power beyond coarse matter, beyond even the finest ethers, before natural forms can be potentialized into life and motion. The conception of Deific wisdom which can arrange such wonderful laws and self-acting conditions is far grander than the God of confusion, too often conceived of, who works very generally without law and who must be constantly supplementing the deficiencies of things by some special efforts.

XXXIX. Count Rumford and the Dynamic Theory.

1. We have already seen the one-sidedness of a mere *dynamic theory* of force on the one hand, or of a mere *material* or *fluidic theory* on the other hand, see Chapter Second, XIV—XVIII. We have also seen in this Chapter, how many mysteries of matter and force stand revealed by uniting both theories in one on the etherio-atomic law. In order that this mere dynamic theory, now so much advocated by scientists, should if possible be laid on the shelf so as no longer to retard the progress of correct knowledge, a little more should be said in this place.

2. In 1798, an eminent philosopher, by the name of *Count Rumford*, read an essay on Heat before the Royal Society, which has been the stronghold of the dynamic theorists, and is perhaps the most plausible thing that has thus far been presented on that side of the question. Of this essay Prof. Tyndall says, "Rumford, in this memoir, annihilates the material theory of heat. Nothing more powerful on the subject has since been written." (Heat as a Mode of Motion, p. 39.) In this essay the Count explained an experiment of boring into steel, while $2\frac{1}{2}$ gallons of water surrounded the boring apparatus, and thus developing an amount of heat that caused the water to boil. Seizing the small amount of steel dust that had been caused by the boring, he had held it up and exclaimed: "Is it possible that

the very considerable quantity of heat produced in this experiment, could have been furnished by so inconsiderable a quantity of dust?" I quote his strongest point, Italics and all, in the following:—"What is heat—is there any such thing as an *igneous fluid?* Is there anything, that with propriety can be called caloric? We have seen that a very considerable quantity of heat may be excited by the friction of two metallic surfaces and given off in a constant stream or flux *in all directions*, without interruption or intermission and without any signs of *diminution* or *exhaustion*. In reasoning on this subject we must not forget *that most remarkable circumstance* that the source of heat generated by friction in these experiments appeared evidently to be *inexhaustible*. It is hardly necessary to add that anything which any *insulated* body or system of bodies can continue to furnish *without limitation* cannot possibly be a *material substance;* and it appears to me to be extremely difficult, if not quite impossible, to form any distinct idea of anything capable of being excited and communicated in those experiments except it be *motion*."

3. It will be seen from the above that Rumford was reasoning on the supposition that heat must be confined to the portion bored, and that the metal acted as an insulator to prevent heat from coming into the water from without. But we have seen how heat and electricity when under stimulus can pass through all substances including atmosphere, water and metals, and how easily the ethers can sweep through steel, as in the magnet, for instance, in which the forces come from the atmosphere and pass into the atmosphere again, as shown by the iron filings which they influence. We have seen that atoms are a kind of wind-mills or fanning-mills into which and out of which the currents of ether flow, their spiral wheel-work becoming especially active when frictionized or pressed so that both the caloric and electricity must be drawn along with the greater rapidity. The Count's reasoning then is on a par with the following, with reference to a fanning-mill:—The fanning-mill is turned and a very considerable quantity of air is "excited and given off in a constant stream or flux" in various directions, "without interruption or intermission, and without any signs of *diminution* or *exhaustion*. In reasoning on this subject we must not forget *that most remarkable circumstance* that the source of wind (heat) generated in these ex-

periments appeared evidently to be *inexhaustible.* It is hardly necessary to add, that any " air which a fanning-mill, *covered with a wire screen* (insulated), " can continue to furnish *without limitation,* cannot possibly be a *material substance ;* and it appears to me to be extremely difficult, if not quite impossible, to form any distinct idea of anything capable of being excited and communicated in those experiments, except it be MOTION."

4. This is parallel to the common reasoning of to-day on this subject. To speak of insulating or shutting out the heat currents by means of steel is very similar to insulating or shutting off the air currents from a fanning-mill by a wire screen. Very many persons are able to feel, as I myself have sometimes done, the warm currents flowing from the negative pole of a magnet and the cold currents flowing from its positive pole. Baron Reichenbach furnishes numerous examples of persons who can do this, and who can see fiery emanations from both poles, the warm red flames coming from the south pole, and blue flames from the north pole, which is more positively electrical. (See Chromo-Dynamics.) Suppose a person should hold his hand in front of the fanning-mill, and, as he feels a strong breeze emanating from it should declare there was nothing there but *motion,* would his observation be considered very scientific ? If not, neither is it scientific to reason in the same way about the ethereal breezes. It is absurd to suppose that there can be motion without something to make the motion.

5. A similar error was committed by *Faraday* in the measurement of electricity. As Rumford presumed that heat can be shut in by a bar of steel so did Faraday presume that electricity can be enclosed and then measured in a drop of water, as signified in the following sentence :—" One grain of water acidulated to promote conduction, has a quantity of electricity equal to a powerful flash of lightning." (Experimental Researches in Electricity, p. 250.) In answer to this statement which has been widely quoted as a fact, I would say 1st, that a grain of water is about equivalent to one drop. A powerful flash of lightning from a cloud doubtless comes from thousands of drops ; is it to be supposed that one drop should equal this ? 2dly, we have seen under the head of Galvanism (XXXIV) that acidulated water, by means of chemical action, brings not only its own electricities into play but

those of the surrounding metals and wires. How then shall its electricity be measured aside from theirs?

6. That all the fine forces of light, heat, electricity, etc., include both atomic vibrations and ethers, should by this time be quite clear to the reader, especially as on this theory so many mysteries of nature stand revealed which on the mere dynamic plan must ever remain inexplicable. I have myself collected several colors on chemically prepared paper, and this directly from the sunlight, with only colored glass between, thus proving that light is a substance as well as the result of vibrations. The following from Prof. Henry, one of our most eminent scientists, shows the fluidic and material side of electricity :—"In a new investigation of the discharge of a Leyden jar, the facts clearly indicated the transfer of a *fluid* from the inside to the outside and a rebound back and forward several times in succession until equilibrium was obtained by a series of diminishing oscillations" (Patent Office Report on Agriculture in 1857.)

XL. Weight and Specific Heat of Atoms.

The specific heat in the following table is given as determined by Regnault and others, and the relative weight of atoms as established by chemists. The real weight of atoms of course cannot be ascertained. Hydrogen is the lightest substance, has the lightest atoms of any which chemists have been able to take cognizance of, and its atomic weight is called 1; the carbon being 12 times as heavy, is called 12, Oxygen 16, etc.; chemists have concluded that all atoms in a gaseous form occupy equal sizes or volumes, those of oxygen gas, for instance, occupying the same amount of space as those of hydrogen, although 16 times as heavy. I will give the names of the substance, then the chemical symbol, as O for *Oxygen*, H for *Hydrogen*, Na (natrium) for *Sodium*, Fe (ferrum) for *Iron*, etc. In compound substances, the different elements and the quantity of each is represented chemically by placing the symbols with figures thus: H_2O for water, meaning 2 atoms (or volumes) of hydrogen to one of oxygen, or eight times as much by weight of Oxygen as of Hydrogen. In the next column I furnish the relative weight of each atom, then the specific heat which each atom has the capacity for as compared with water, then the products of the specific heat multiplied by

	Elements.	Symbols.	Atomic weight, Hydrogen being 1.	Specific Heat, Water being 1.	Products of specific heat multiplied by Atomic Weight.
	Gases.				
	Hydrogen	H.	1	3.4046	3.4046
	Nitrogen	N.	14	.244	3.416
	Oxygen	O.	16	.2182	3.4912
Compound Bodies.	Air			.2377	
	Carbonic Acid	CO_2		.3308	
	Watery Vapor			.4750	
	Liquids.				
Compound Bodies.	Water	H_2O		1.0000	
	Alcohol	C_2H_6O		.615	
	Ether	$C_4H_{10}O$		.5113	
	Chloroform	$CHCl_3$		.2293	
	Bromine	Br.	80	.106	6.744
	Mercury	Hg.	200	.0333	6.66
	Solids.				
Carbon.	Diamond	C	12	.147	1.764
	Charcoal.			.242	2.904
	Sodium	Na.	23	.2934	6.748
	Magnesium	Mg.	24	.2499	5.998
	Aluminum	Al.	27	.2143	5.786
	Silicon	Si.	28	.176	4.928
	Phosphorus	P.	31	.1887	5.8497
	Sulphur	S.	32	.2026	6.483
	Potassium	K.	39	.16956	6.6128
	Manganese	Mn.	55	.1217	6.6934
	Iron	Fe.	56	.11379	6.3722
	Nickel	Ni.	58	.10863	6.409
	Copper	Cu.	63.5	.09515	6.0419
	Zinc	Zn.	65	.09555	6.2108
	Silver	Ag.	108.	.05701	6.157
	Cadmium	Cd.	112	.05669	6.3482
	Tin	Sn.	118	.05623	6.6356
	Antimony	Sb.	122	.05077	6.1939
	Iodine	I.	127	.05412	6.8732
	Gold	Au.	196.7	.03244	6.38
	Platinum	Pt.	197.4	.03243	6.3952
	Mercury (Solid)	Hg.	200	.03192	6.384
	Lead	Pb.	207	.0314	6.4999
	Bismuth	Bi.	210	.03084	6.4764

the atomic weight, which makes about the same amount for nearly all the elements. Dulong and Petit were the first to deduce the law that *the specific heat of an elementary body is inversely as its atomic weight.* The rule seems to be that *the greater the thermal*

activity and capacity of an atom the less is it liable to be loaded down and saturated with gravito-ether, whose attractive principles give the effect of weight. The heaviest atoms do not always make the heaviest substances, as bismuth, whose atoms are the heaviest of all, is not 10 times as heavy as water, while gold is so compact as to weigh over 19 times more than that fluid. The formula for Alcohol as above is C_2H_6O, 2 equivalents (volumes) of Carbon, 6 of Hydrogen and 1 of Oxygen, or by weight 24 parts of Carbon, 6 of Hydrogen and 16 of Oxygen.

XLI. Latent and Sensible Heat.

How is it that atoms become so vastly expanded when in the gaseous state over what they are in the liquid or solid condition, or when heated, over what they are when cold? The channels formed by the spirillæ around the main spiral through which the fluid ethers flow, must ever remain much the same in size excepting under great pressure (See XXXIII), otherwise we could not get the same color continuously, or the same grade of electricity within the same spirilla, for if it grew larger or smaller it would vibrate at different rates and attract different grades of ethers. The atoms of water expand nearly 1700 times on being converted into steam, and something wonderfully elastic and spring-like must be thus projected outward by the centrifugal force of the heat currents. As the thermo-spirals form the *channels* of the ordinary heat currents, suppose we consider the tube of the same. Within this tube is the spiric ether, which, though static to some extent, yet like the static atoms of jelly may be supposed to move about only with incomparably more freedom than that substance from its great fineness. This spiric ether must be swung with tremendous velocity against the outside portion of the tube which contains it, causing it to project in case it is thin and elastic. That it must be thin would seem to be indicated by the fact that the billions of revolutions and vibrations of the heat forces every second, acting ever centrifugally, are constantly hurling this ether against the outward membrane and thus rendering it pliable. Knowing now as we do, that something must protrude far beyond the body of the atom, and that this something may be thus naturally accounted for by this elastic and

pouch-like membrane of the spiral tubes driven outward by the momentum of the ether within, I think we may settle down upon this as the correct hypothesis. The greater the heat action, other things being equal, the farther will this membrane be projected outward. In gases, there is no power to hinder it, and it may thus extend very far. *Now this spiric ether while within its tube may be called latent heat, but when it is projected outward its ribbon-like membrane, lashing against all surrounding objects gives the burning effect of sensible heat causing the thermometer to rise.* Of course the fluid ethers must combine with this lashing to give the full effect of heat, and excite the spiral tube itself. But why, it may be said, is the heat of boiling water more severe to the sensation even than that of steam, as long as the atoms are so much nearer together and the lashing membrane so much shorter? Because 1700 times as many lashes are laid on in the same space by water as by steam, so they make up in number what they lack in length. This shows why the latent heat generally diminishes in proportion as the sensible heat increases, as the spiric ether lessens in its tube as it is projected externally. According to the experiments of Clement and Desormes, a certain weight of steam at 212° F. condensed into water at 32° exhibited :

Of Sensible heat, 180°—of Latent heat, 950°,—total 1130°.

The same weight at 250° manifested :

Of Sensible heat, 218°—of Latent heat, 912°—total 1130°.

The sensible heat, it will be remembered, is that which is measured by the thermometer.

XLII. Theories of Atoms.

1. It is becoming more and more apparent to men of thought that the knowledge of atoms is the foundation stone of the temple of Science. The ignoring of the fine ethers, however, which vitalize and propel the atoms, has made it a very difficult matter for them to gain any kind of rational conception of how they work. Tyndall and others very correctly conceive that there is some spiral style of movement connected with heat, and yet the following is his conception of the matter : " I have here a weight attached to a spiral string ; if I twirl the weight round in the air, it tends to fly away from me, the spring stretches to a cer-

tain extent, and as I augment the speed of revolution the spring stretches still more, the distance between my hand and the weight being thus augmented. It has been thought that the augmentation of the distance between a body's atoms by heat may be also due to a revolution of its particles. And imagine the motion to continue until the spring snaps; the ball attached to it would fly off in a tangent to its former orbit, and thus represent an atom freed by heat from the force of cohesion, which is rudely represented by our spring." Thus does Tyndal hint at a "revolution of particles." If he means a revolution of etherial particles around the main atoms through some directing lines of force or spiral spring work, then it is clear enough just how this "revolution" can be effected; but if he means that the main atoms revolve spirally around each other without any guiding force, or channel, to systematize this revolution, the mystery is as great as ever; for *how could they ever become polarized or crystallized in the midst of this constant whirl, and whence comes their propelling power?*

2. *Molecular Astronomy.* I have just met with a very good synopsis of the views of scientists on these revolutions of atoms which is strangely confirmatory of what I have already been stating with reference to the atomic structure when viewed in one light and yet strangely absurd as a whole. The theory is very pretty, and it is given in *All the Year Round*, from which I quote the following:—

"Comparing the infinitely small with the infinitely great, it is held that a body, of what kind soever, represents in miniature and very exactly, an astronomical system, like those which we behold every night in the firmament. If we could construct a miscroscope of sufficient power, we should be able, by the help of such an instrument, to resolve the molecular constellations of every little terrestrial milky way, exactly as our first rate telescopes resolve the celestial nebulæ and separate double and triple stars. Were our sight sufficiently penetrating we should behold what now appear mere confused heaps of matter, arranged in groups of admirable symmetry. Bodies would appear honeycombed in all directions, daylight would stream through vast interstices as it does through the columns of a temple or the tree trunks of a forest. Nay, we should see immense empty spaces,

like those which intervene between the planets. From distance to distance, too, we should perceive clusters of stars, in harmonious order, each surrounded by its own proper atmosphere ; and still more astounding spectacle !—every one of those little molecular stars would be found revolving with giddy rapidity, in more or less elongated ovals, exactly like the great stars of heaven ; while by increasing the power of our instrument, we should discover around each principle star minor stars—satellites resembling our moon—accomplishing their revolutions swiftly and regularly. This view of the constitution of matter is aptly described by M. de Parville as *molecular astronomy*, maintaining even that astronomy, without our suspecting it, is dependent on minerology; and that whenever we shall have discovered the laws which govern the grouping and the movements of the infinitely small, astronomers will have only to follow in our track. But who, a hundred years ago, could dare to imagine that the infinitely small was so infinitely great? What is now believed to be the nearest guess at the truth appears, at first sight, to be the dream of a madman."

3. This system of *molecular astronomy*, with its circles within circles, is remarkably in harmony with what I have ascertained must be the law of the atom, working with its spirals and different grades of spirillæ, with its flow of small ethereal atoms which revolve around and through the main atoms and its still more delicate atoms that circulate through them. But it is an immense absurdity to suppose that atoms exist at great distances apart in open vacuity, which must at once make them independent of the rest of the universe and cause immediate lawlessness and ruin. It can be shown that the gravitation which holds all worlds in their orbits would at once cease were there not an almost infinite series of atomic pathways held in a beautiful polarity and contiguity by means of sunbeams and starbeams through which the amazingly swift and attractive ethers pass and repass and hold suns and systems to their allegiance.

4. Mr. L. R. Curtiss, in an article on *Molecular Magnitudes* in the Popular Science Monthly, of Oct. 1877, uses the following language : " As to the shape and internal structure of atoms, there is no definite knowledge, but Helmholtz's studies of certain equations in hydro-kinetics, several years ago, gave rise to the idea that vortex motion in a frictionless medium would exist for-

ever—an assumption which is purely hypothetical; but since the proposition has been enlarged upon by Sir William Thompson—who conjectures that the atoms might be filaments or rings endowed with a vortex motion—the subject assumes a shape better calculated to form the basis of a scientific theory." The above shows that scientists are approaching more and more nearly to the true conception of atoms. But when Helmholtz, Thompson, and others talk about a vortex, they are considering something altogether vague, unless they also admit the necessity of fluidic ethers to sweep through this vortex, for otherwise the atoms must be as lifeless as a windmill without wind.

5. These and many other atomic theories are pretty and ingenious, and give some conception of the immense movements that are ever taking place among atoms, but *how* these movements occur and *why* they occur, and what is the philosophy of molecular action, has thus far never been presented, so far as I know. A thousand hypotheses concerning atoms may be propounded; but so long as they are not reduced to definite law and harmonized with the mechanics of nature, they will be entirely unable to unfold the fundamental principles of light, color, heat, electricity, magnetism, physiology, psychology or dynamics of any kind, and the world must continue to build on conjecture.

XLIII. Summation of Points in Chapter Third.

1. *Correct science is impossible without a knowledge of atoms.*

2. *All things are comprised under the terms force and matter.*

3. *While the largest atoms are inconceivably small, they are vast as compared with those of the finest ethers.*

4. *The form of atoms must be that of an oblate ovoid, or the shape of an egg flattened somewhat on the sides, from the necessities of force. This form is not solid, but consists principally of an immensely elastic spring-work of spirals encircled by spirillæ of different grades, which form constant channels of force. These channels move spirally around the outside of atoms as the principle of expansion and heat, and forming a vortex at the larger end, pass through the center in the other direction, tending to draw the atom in smaller on the principle of cold and electricity.*

5. *The smaller positive end of the atom has the greater intensity of heat,*

cold, repulsion and efflux power; the larger vortical or negative end is the point of greatest attraction, and influx power.

6. *Ordinary atoms must have certain spirals that are more external and projecting than the others, which are finer and set farther within. The external are known as extra-spirals, the internal, as intra-spirals. These pass within as axial extra-spirals and axial intra spirals.*

7. *The thermo or extra-spirals are the principle of the ordinary coarser grades of heat, and when passing axially are the principle of the coarser grades of cold and also frictional electricity, which last works much like thermo-electricity. The intra-spirals in transparent bodies are the pathway of the warm or thermal colors, and when moving axially, of the electrical colors. In somewhat coarser and opaque bodies these same spirals become the principle of coarser grades of heat, and when moving axially, of the chemico, galvano and magneto electricities.*

8. *Atoms in harmony with all mechanical action are kept in movement by fluidic forces. These forces are called ethers and are guided and drawn on by and through the channels called the spirillæ. The finer spirillæ respond to the finer ethers.*

9. *Ethers have weight, otherwise they could not have momentum.*

10. *Polar cohesion is caused by the flow of ethers which sweep and draw the positive end of one atom into the larger vortical end of a contiguous one. Lateral cohesion is caused by the contiguity of positive and negative thermo-spirals.*

11. *The unity of atoms requires that the spirals and spirillæ should be connected with each other by various little pillars or tubes from one to the other. These pillars may be termed atomic tendrils.*

12. *The most common method of polarization among atoms is in converse layers, in which the lines of atoms run side by side, but alternately in opposite directions. Transverse layers are those which cross each other at right angles or nearly so; transverse diagonals, those which cross diagonally and irregularly, while paraverse layers have all the atoms of a layer pointing in the same direction.*

13. *Heat tends to individualize and disintegrate, cold to organize and make rigid; both combined to create harmony. It is only the coarser grades of heat and cold which are most painful to endure. The finer grades are more soothing and penetrating. The different grades of electricity are simply grades of cold.*

14. *Polar cohesion is aided by the flow of electricities, and in hard or solid bodies, doubtless, by a special riveting arrangement called the ligo.*

15. *There are six especial divisions of electricity,* 1, *the frictional;* 2, *Chemico electricity;* 3, *Galvano electricity;* 4, *Magneto electricity;* 5, *Chromo electricity; and* 6, *Psycho electricity. Other grades exist in connection with the fine spirillæ, etc. Frictional electricity is the most interior and probably the swiftest, psycho electricity the finest, and chromo-electricity somewhat coarser, while chemico electricity is slow and negative. Unanswerable facts show that the various shades of blue, indigo and violet are electrical.*

16. *Magnetism consists especially of two leading grades of electricity, the more positive of which is the magneto, the more negative, the chemico, deflected to a great extent into curves by the transverse polarization of the atoms of certain substances through which they pass. The negative, sometimes called the south pole of the magnet, is saturated with the chemico electricity, the positive pole with magneto and perhaps galvano electricity, being stronger in both its attractions and repulsions than the negative pole.*

17. *Diamagnetic substances are those which have a lateral axis, instead of a longitudinal one like that of the magnet, and this comes from the polarization of its atoms into transverse diagonals.*

18. *Phosphorescence, like every other style of combustion or chemical action, is always developed in connection with some grade of electricity, whether caused by vital action, the blue color, or otherwise. Its light is of too fine a grade to give the painful heat sensations of ordinary burning objects.* (*See XXI.*)

19. *Fluorescence, Calorescence, etc., prove that under the stimulus of chemical or electrical action, fine ethers can sometimes be attracted through spirillæ which are naturally too coarse for them, and coarse ethers driven through spirillæ naturally too fine for them.*

20. *In galvanism the acid or other substance used is polarized conversely with the molecules of water, the galvano and magneto electricities passing through the water from the platinum to the zinc, and so on through the circuit, while the chemico electricity passes through the acid in the other direction.*

21. *In frictional Electricity there are not two kinds of electrical force passing in two directions, as is often supposed.*

22. *A negatively electrified body, or part of a body, is one in which the influx electrical currents preponderate over the efflux ones, while a positively electrified body, or part of a body, is one in which the efflux currents preponderate over the influx ones. Positiveness of electrical power sometimes depends upon the quantity and tension of electricity in one body as opposed to less of the same in another, and sometimes upon a stronger as opposed to a feebler quality of electricity, as the magneto in one substance as opposed to the chemico in another.*

23. *Chemical affinity occurs between atoms that have been made full and wide mouthed from their strong thermal and vortical action and those that have been made more narrow from their strong electrical action, especially if some similar grades of ether are able to pass through and connect them both. The most direct affinity occurs between the electro-positives, including the alkalies, and the electro-negatives, including the acids, the former having the more wide mouthed atoms, the latter, the more pointed and electrical atoms. The electrical colors affinitize with the thermal colors.*

24. *Atoms constitute at once the most perfect of machines and yet possess many leading characteristics of an animal.*

25. *The reason why the etherio-atomic law is a key to unlock so many mysteries of science, is, that it adopts the system of duality so universal in nature which combines the form and working of atoms as the base work of matter and the vitalizing flow of ethers, as the instruments of force, neither of which departments can ever be divorced from each other any more than action can be sundered from reaction.*

26. *The heavier the atom, the more feeble is its capacity for heat.*

27. *Scientists are right in presuming that atoms revolve around other atoms like planets around their parent sun, but these revolving atoms constitute the ethers which circulate through their spiral orbits around the parent atom. The orbits are brought to the most unerring system by means of the 1st, 2d and 3d spirillæ which represent orbits like those of the moon, earth and sun.*

28. Thus is an atom an epitome of the universe, having a gradation of elliptical and spiral orbits in imitation of those of the solar system; having its axial center of unity around which its external spirals revolve as a principle of diversity; having its positive end at which repulsion rules, and its negative end at

which attraction is the dominant principle; constituting the most marvelous of machines with wheels within wheels driven by water, even the water of ether, some of which is much swifter than the lightning; resembling also an animal with veins, arteries, nerves, spine, viscera, blood, nerve-force, etc. In general form it resembles the egg, which at one time was thought to be the starting point of all life, Harvey having written "*omne vivum ex ovo.*" Atoms indeed are the eggs out of which the whole universe is built, though on quite another principle. Their activities are so amazing that if one of them could be enlarged to the size of a man's head, constructed of some material millions of times stronger than anything known upon earth, and the tremendous whirl of forces set to revolving through their spirals which at their ordinary speed vibrate several hundred trillion times a second, what must be the effect? If such an atom should be set in the midst of New York City, it must create such a whirlwind that all its palatial structures, ships, bridges and surrounding cities, with nearly two millions of people, would be swept into fragments and carried into the sky.

If the reader has become familiar with the foregoing chapters and gained possession of the atomic key, I think we shall be able to go hand in hand through many hidden pathways of power and open new doors in the infinite temple of knowledge.

CHAPTER FOURTH.

THE SOURCES OF LIGHT.

I. Introductory Point.

Whence is the radiation that kindles all things into brilliance, and without which the whole universe would be but an infernum of blackness and death? It is meet that we should mount from atoms to suns, nature's opposite extremes of wonder. Opposite Extremes, did I say? They are identical, for suns and planets are but aggregations of atoms.

II. World Formations.

Something concerning cosmical formations will explain the existence of suns and fixed stars, or the luminous worlds, and also of the planets and moons, which are non-luminous. The etherio-atomic key opens up the law of forces so clearly as to make it evident that astronomers with all their wonderful achievements have committed some important errors in getting at the development of worlds and of cosmical forces. For many years there has been a great division of sentiment as to whether the universe is the result of instantaneous creation, or of progressive growth and development from nebulous conditions. The nebulous theory declares that originally world matter was spread out through space in cloud-like forms of almost immeasurable extent. Scientists have often spoken of this as having been caused by a heat so intense as to convert liquids, metals and mineral forms generally into a vapor which is thus spread out through space, and which is finally condensed into suns and worlds by natural processes. The prize essay of the World's Evangelical Alliance, written by Mr. Pearson, admits that the world is far older than six thousand years, but considers that all things were spoken into existence from nothing. He thinks that because the tele-

scope has resolved many of the nebulæ into stars, it will yet resolve all of them and thus put an end to the nebular theory which signifies progressive development. But an instrument keener in its powers of analysis than the telescope has come out against him, namely the spectroscope. Prof. Draper in 1846 proved that the spectrum of an ignited solid is always continuous, just as Fraunhofer had still earlier shown that the spectrum of ignited gases is discontinuous, or broken by lines or bands. Of 70 nebulæ examined by Huggins, about one-third gave discontinuous or gaseous spectra, and the others continuous ones, and other observers have arrived at about the same result, thus proving the truth of the nebular hypothesis and showing that the divine activity is unceasing in its grand processes of development.

III. Nebulous Matter.

The idea that this nebulous or world-forming matter must necessarily be intensely hot is evidently a great mistake. When matter has been thus spread out in the intensely cold realms of space and especially with such great tenuity, and kept there for untold ages, it must naturally become cool excepting where chemically excited. But how can heavy metals and liquids be held in such a vaporous and etherial condition without heat, it may be asked? To this it may be answered that the substance which, in a sun or planet, constitutes a metal, is not necessarily a metal while in the nebulous condition, but exists in a negative, unformed state just as the oxygen and hydrogen, which compose water, may exist side by side without combining, in a gaseous state which is 2,000 times as expansive as water itself. I think it will sometime be ascertained by chemists that iron, lead, silver, gold and other supposed elements, are really substances which are chemically combined in molecules from heterogeneous atoms, but united so closely that no analytical power has yet been able to disintegrate them. That at least might help account for some of their intensity of cohesion and finer and coarser grades of atoms which exist in the same element. But why do they thus expand in open space without cohering as metals? Because their affinitive ethers are not sufficiently powerful to drive them into union. They constitute *a good example of the utter helplessness of all matter when*

divorced from its ethers. But how are we to get these great cloud-masses converted into worlds, and especially into the great fiery worlds which we call suns? Can cold, nebulous, vapory matter turn into fire-balls?

IV. The Sun Forming Process.

It should be understood that all combustion is simply a chemical process. This chemical union may be induced by electricity, or mechanical force, or heat. We have seen how a cloud, positively charged with electricity, coming in contact with a cloud more feebly charged, sends its superabundant ethers into its neighbor with great power, causing the flash of the lightning and a peal of thunder. (Chapter Third, XXXVI.) We will now suppose that two great cloud masses of nebulous matter approach each other. They may be millions or even billions of miles in diameter. One of them has become far more powerfully charged than the other with the electric radiations from distant suns. Why should one mass of nebulous matter become more highly charged than another? From being nearer to some central sun around which both are moving, and thus being able to receive the electricities of that sphere more powerfully. All matter, it should be remembered, must be moving around some other more powerful center. This charging may have been going on for thousands perhaps millions of years, for nature is sublime in her periods of time as well as her achievements of power. When this charge of forces is fired into the negative world-mass, can any human mind conceive of the almost infinite burst of power, the shock of which must vibrate even to far off starry worlds? These tides of electricity would sweep the oxygen into the hydrogen to form watery vapor, into the sulphur to form sulphides, into the calcium to form lime, into the silicon to form silica or flinty substance, into the carbon to form carbonic acid, into hydrogen and sulphur to form sulphuric acid, would drive the chlorine into the sodium to form common salt, would unite hydrogen and chlorine to form hydrochloric acid, would send the metallic atoms into union and start altogether a process of action which thenceforward and forever must have no end. These masses, and perhaps many other similar ones thus segregated into oxides, metals, etc., would become aggregated by gravitation into a single mass. The heat

that would be developed by these processes must simply be indescribable, and all things must exist in vaporous conditions. Let us see some of the steps of progress. The attraction of gravitation uniting with cohesion and chemical force, then rounds it out into a vast sun-globe, compared with which our own sun is quite a minute affair. From some cause, perhaps from a powerful eruption on one side, it is set into an axial whirl. But the great flaming, seething mass of fire is too furious in its chemical repulsions to settle into peaceful action, and thus vast explosions take place, sending their burning fragments trillions of miles into space. These fragments contitute a new family of suns, one of which is our own central sphere. I say sphere, for being in a fluid or plastic condition, gravitation acts equally in all directions from a common center, and hence it must be mainly globular. The original central globe, however, remains powerful enough to attract all the other suns around itself. The translatory motion of our own sun through space is said to be carrying it onward toward the constellation Hercules.

V. The Planet Forming Process

1. When our sun was sent out into space, its projecting power was evidently exerted more strongly on one side of its mass than on the other, so that it gained a rotary motion around its axis once in about 25⅓ days. But our sun itself in its earlier cruder condition, when its gaseous, electrical and chemical disturbances were terrific, was subject to eruptive action which sent off masses of matter into space, and which, being fluidic from the amount of heat, were formed by gravitation into globes or planets, of which our earth is one. These planets for a long time until they were cooled off, were simply smaller suns being self-luminous, or incandescent from their radiant heat. A great world like Jupiter, equal in size to about 1300 earths, must have retained its character as a sun for a long time before cooling off, while a small world like Mars lost its excessive heat much sooner and has probably marched forward to a greater maturity than our own planet. A great argument to show that the planets must have emanated from the sun is the fact that that sphere has an axial motion from west to east while all the planets move

in their orbits and mainly in their axial rotations from west to east, having evidently received their motions from the parent sphere. La Place and others admit that the planets must have emanated from the sun, and as far as revealed in the spectroscope the same elements exist in the sun as on our earth. The moons, however, doubtless emanated from their planets, and move in harmony with their axial motions. So we see that all planets and moons move nearly from west to east in their orbits through the heavens, and all worlds, as far as known, move from west to east on their axis. This harmony of direction in the sun, planets and satellites, parallels the harmony of direction in the atomic spirals and different grades of ethereal atoms match the different grades of planets. Thus the main atom is the great central sun (Alcyone), the ethereal atoms which revolve around it through the 1st spirilla are the smaller suns, those of the 2d spirilla are the planets, those of the 3d spirilla, the moons. Do not the infinite lines of gravito-ether which hold all spheres to their central orbs, work with the greater perfection from this harmony of motions ? Truly nature is harmony.

2. Thus we see that our earth and its sister planets were all once suns. After a vast series of ages when they became cooled into greater solidity, some of their gross part formed into a hard crust which constitutes the soil with its various rocks and minerals; a finer substance, existing as steam, was condensed into water, and a still more exquisite condition of gases was converted into an atmosphere which gradually became sufficiently refined to promote vegetable and animal life. All their interior portions, however, must still remain in a molten condition.

VI. Comets.

All space seems to be more or less filled with floating clouds of nebulous matter, portions of which are often drawn to the earth in the form of meteors and aerolites, larger masses move around the sun as Comets, while still greater masses exist in far off space as more immediate materials for world building. Huggins ascertained by means of the spectroscope that in some distant gaseous nebulæ, hydrogen and nitrogen and some other material unknown on earth were to be found, and repeatedly

found Carbon in comets. But comets are now known to be *self-luminous*, at least when sufficiently near the sun to become ignited by the solar electrical and thermal forces, although when far removed they must naturally contract greatly in size and become dark. Why do comets thus become visible and luminous while so much of the other nebulous matter is never seen? Probably because it has more hydrogen, the most intense of all substances in its heat action, and especially quick to ignite when combined with affinitive substances, such as oxygen, etc. The aqueous vapors of the atmosphere, or of a comet or other nebuous mass, must be especially quick to become incandescent before the impact of sun-forces or even of distant star-forces when the Chemical proportions are favorable. So the gaseous nebulæ must exist in all grades of heat and cold, of darkness and luminosity, as well as of material, and it probably requires a



Fig. 150. Comet of 1680 with a length of 120 million miles.

variety of nebulæ to afford the full material for a world. Comets are so very attenuated and misty as to come as near being *an illuminated piece of nothing* as anything we can conceive of. The comet of 1843 was at one time expanded so that its tail reached 200,000,000 miles into space. Comets move with their nucleus toward the sun and their tails in the opposite direction. The cause of this is that the nucleus being more dense becomes first heated, then as thermo-electricity always moves from a warm to a colder region, it must pass from the nucleus toward the colder realms of space, which must necessarily polarize the mass of the comet in a direction opposite to that of the sun. Lalande enumerates 700 comets, and Arago thinks there are as many as 7,000,000 in the solar system. Their orbits are exceedingly elliptical, and in every conceivable direction, so that their substance could not have come from the sun as did the planets. The comet that appeared in July, 1844, requires more than 100,000 years to make its journey around the sun, while some comets moving in the curve of an hyperbola must go off into distant starry systems never to return. But even these seemingly law-



Fig. 151. Halley's Comet.

less comets are subject to law and are always doing obeisance to some sun around which they revolve, or responding to some planet or nebula which they may approach, ever giving and ever receiving from all quarters. The comet of 1680 (fig. 150), beautiful in its gradations and contrasts, having a center of unity at its head which widens into an exquisite diversity, is not to visit us again before the year 2485, according to Encke. Fig. 151 is only one of the various forms which Halley's Comet exhibited to us. Its next appearance will be in 1911.

VII. Refinement of Matter.

We have already seen that everything is on an ascending scale, from the crude, eruptive and fiery conditions of nascent world-life to the calmer conditions of cooled-off planets, and thence through all the geological ages to the present time. We know how fruits, vegetation and animal life have ever been reaching up into greater refinement and superiority from the lapse of time. Romance talks of the "*good* old times"; Truth speaks of the *crude* old times. What I wish to impress upon the reader is, that *atoms and etherial forces are ever tending to greater refinement and subtilty, and that some atoms are more refined than others of the same element.* This is a point of great importance, for without it the phenomena of matter and force can never be correctly understood. It will explain the allotropic conditions of the same element and many other mysteries. Thus *ozone* (+O or O) is the finer part of oxygen, while *antozone* (—O) is the coarser, and both combined will produce oxygen (O). Ozone is more electrical and potent as an oxydizer and bleacher than ordinary oxygen, and gives great purity and vitalizing character to the air. Its atoms are probably lighter than the average ones of oxygen, and yet ozone of itself is heavier, probably from its strong electrical currents which draw its atoms into a narrow compass, just as sulphuric acid when put with water condenses it by its powerful electricity. When the sun does not shine, the ozone

seems to rise above us, as it is known to be deficent in the air around us, but under the electrical force of the sun it is driven down to the surface of the earth in much larger quantities.

2. Again, let us take *diamond* and *plumbago*, which last is sometimes known as black lead or graphite. These are both crystallized forms of carbon, and yet there must be a decided difference from some cause. Diamond transmits the light, but not ordinary electricity; plumbago is a good conductor of electricity, but totally excludes the light. In other words diamond is evidently of a finer grade of carbon atoms, as it transmits a finer substance through its spirillæ. But some may say the diamond is crystallized differently, and hence its transparency. But glass and water cannot be put into any kind of connected arrangement without permitting *some* light to pass through them, while plumbago is constantly opaque. Transparent atoms cannot be crystallized in any possible way so as to exclude the light in all directions, and this should be proof that diamond and plumbago possess different grades of fineness.

But *through the whole atmosphere are floating particles of nearly if not quite all of the substances of the earth.* M. Nordenskica has analyzed the metallic substances iron, nickel and cobalt found in the atmosphere at 80° north latitude. "There are," says he, "invisible and infinitely minute grains of cosmic oxygen floating in the air." M. G. Tissandier communicated to the French Academy of Sciences the results of his experiments which show that a vast number of the particles of solid substances are volatile in the atmosphere. The spectroscope shows that particles of sodium exist everywhere in the air, while chemists have taken cognizance of carbonic acid, ammonia, nitric acid, carburetted hydrogen, aqueous vapor, and other elements as being common. Is not this a good argument in favor of the superior fineness and lightness of atoms which thus float? The sweep of ethers through all substances seems to carry off their lighter atoms into the air where very many of them continue to float. We may easily conceive that very refined iron and some other magnetic substances may receive slight assistance in becoming volatile from the strong magnetic currents of the far north, but what about, sodium and other elements whose ordinary atoms are much heavier than those of the atmosphere? If there is not a finer, lighter grade

of sodium, how could it thus float, for the common sodium atom is 23 times as heavy as that of hydrogen, while the nitrogen and oxygen of the air are respectively only 14 and 16 times as heavy. To say that a light substance can float a heavier one is like saying that water can float a rock. We may safely conclude, then, that atoms which float in the air are generally lighter than those of the air itself, and that the lighter atoms, other things being equal, will float in higher portions of the atmosphere than the heavier ones; that those of nitrogen, for instance, will naturally float a little higher than those of oxygen, being one-eighth lighter, that those of carbon will float a little higher than those of nitrogen, being one-seventh lighter, that the lithium atoms will float higher than any of these substances, being only one-half as heavy as those of nitrogen, while those of hydrogen will float far higher than any others, being seven times as light as those of lithium, the lightest of atoms next to hydrogen.

4. Another important fact explained on the supposition of different degrees of refinement in atoms, is the exquisiteness of the gradation of colors. While, as we have seen, there are probably seven thermal and seven axial spirillæ for the fourteen leading colors of the spectrum, including the thermel, yet there are very many times this number of hues and tints progressing from one to the other by imperceptible degrees, thus showing that one line of atoms may be a little finer than the contigous line. For instance, we may have a line of atmospheric atoms with spirillæ for yellow-orange, then another somewhat finer line, in which the same spirillæ produces a very yellow-orange, or almost yellow, and so with other spirillæ. In this way we get the beautiful variety of nature.

5. A mystery which is also solved by this hypothesis, is the fact that iron and some other minerals have been found hurtful to sensitive stomachs when taken in the ordinary mineral form, but very bracing and useful when taken in the vegetable form, which goes to show that the vegetable processes cannot take up the heavier and grosser atoms of a mineral substance, but rather its finer ones which are necessarily much better adapted to so fine an organization as the human system.

We are now prepared to appreciate the next very important point.

VIII. The Atmosphere of Space.

From the last paragraph we see that the atoms grow more refined and light in proportion as we rise from the earth's centre into the sky. Although the earth's atmosphere is not sufficiently dense to sensibly refract light over 45 or 50 miles in height, still its more volatile atoms and especially its hydrogen, must be continued on into space. *Has it not occurred to our scientists, who admit that there is an ether pervading all space, that this ether must simply be the extension of hydrogen from the atmosphere of the different suns and worlds? Is not this the real* COSMIC ETHER, *the bridge-work formed on the most natural plan, over which the sun forces, star forces, planetary forces and nebulous forces pass and repass throughout the infinities of space?* The following are some of the reasons for this hypothesis :—

1. Hydrogen is the lightest of all known atoms, consequently it would naturally gravitate into space higher than the other atoms.

2. Hydrogen constitutes about two-thirds of the atoms of all water and all aqueous vapor, consequently the hydrogen atoms that are thrown off by all oceans, lakes, rivers and clouds must rise higher and higher into space in proportion as they become refined.

3. Hydrogen is produced from water or aqueous conditions by means of heat, electricity and chemical action, all of which exist on the most immense scale in the sun and fixed stars, which by their propulsive forces in connection with planetary and nebulous action, would seem quite sufficient to fill all space with this gas in a more or less attenuated condition.

4. The spectroscope has shown that there is a vast atmosphere of luminous hydrogen surrounding the sun, which, sometimes, during the solar cyclones, projects hundreds of thousands of miles into space. Is it reasonable to suppose that the hydrogen atmosphere stops with that which happens to be made visible by the solar heat ; especially when we consider the almost infinite fountains of hydrogen gas that are sent forth by this very heat itself ?

5. Hydrogen has an unequaled capacity for heat, has also a fine capacity for electricity, and is the most elastic and ethereal

of all known atoms, hence it is best adapted to form the pathway for the ethers which convey heat, electricity, light, color and gravitation through interstellar space. "There is some indication, from the identity of coronal with zodiacal light and auroral lines, of the existence of a very attenuated atmosphere extending largely throughout space." (Roscoe's Spectrum Analysis.)

6. There being nothing then seemingly to limit the expansion of the hydrogen over space, and especially as it is eminently suitable to act as a series of *carrier* atoms, we may deem it the real cosmic ether. The blending of the earthly and ethereal



Fig. 152. The Ethereal Atmosphere of Space.

atmospheres I have represented by fig. 152. As it reaches far into space it must become very ethereal in its nature, and yet must have weight. The region between the sun, and earth at which its refinement and lightness is greatest, must be incomparably nearer the earth than the sun from the fact that the sun is 320,000 times as heavy as the earth, and its attractive force must be sufficiently great to condense this ethereal gas as fully at a long distance as our earth can at a short distance. "The luminiferous ether," says Ganot, "occupies space, and although

it presents no appreciable resistance to the motion of the denser bodies, it is possible that it hinders the motions of the smaller comets. It has been found, for example, that Encke's comet, whose period of revolution is about $3\frac{1}{3}$ years, has its period diminished by about 0.11 of a day at each successive rotation." (Cours Elémentaire de Physique.) When I speak of hydrogen as forming the atmosphere of space, I mean to say that it is doubtless the leading element in this atmosphere, especially in its more refined forms, but all other elements also are capable of becoming refined and volatile, they probably form some portion of the same.

7. I have called this a *static ether.* This is a proper place to gain a clear idea of what is meant by a *static* or *stationary* ether. When the atmosphere is calm, it is polarized conversely by the sunlight, with the more positive tide of forces streaming *toward* the earth in the day time, and *from* the earth in the night. It then resembles a static ether. It does not signify that the ether is so stationary that it may not be swept into currents or waves by counterforces, and those which at times may be far swifter than the grosser atmospheric currents. But these do not depolarize the atoms in a way to essentially hinder the flow of luminous ethers from the sun to the earth and other planets.

8. The finest portion of this ether must come from the earth and other planets rather than from the sun. *The condition of all suns is far more primitive and crude than that of planets,* and must be what our earth was many millions of years ago before it became cooled off and commenced its refining processes.*

* The eminent scientist Helmholtz says, "The period of time during which the earth has nourished organized beings, is still very short when compared to the period during which it was a mass of molten rock. Bishop's experiments on basalt appear to prove that to cool down from 1000° to 200° Centigrade, our earth must have taken 350,000,000 years. As to the length of time that has been required by the original nebula to condense itself into the form of our planetary system, it entirely defies our imagination, and all conjectures." And yet after all these almost infinite eras of time through which the earth has been struggling in order to get into condition for man to live in comfort, Prof. Proctor says, "we find the earth gradually tending towards the end." Why? Because the atmosphere which formerly consisted greatly of "hydrochloric acid and sulphuric acid," lost these ingredients and became mainly "carbonic acid," while when vegetation commenced the carbonic acid was absorbed and our present atmosphere took its place. But this is a mere refining process. Is there anything alarming about having the atmosphere drop off its more poisonous elements and become more pure? "It seems conceivable," he says, "that other parts of

Does this signify that sunlight is a coarse element? By no means, for its cruder elements are strained off by the sun's outer atmosphere, or *deposited with the nebulous matter of space and still further refined by our* own atmosphere until it becomes one of the most exquisite forces in nature.

9. In fig. 153, is a representation of the way in which the atoms must be arranged in this cosmic ether. As will be seen, they are arranged conversely, the line *a* at the left carrying the thermal forces from the sun to the earth, and the electrical forces from the earth to the sun, while the very next line exactly reverses the process, thus allowing the electrical forces to pass both ways and the thermal forces both ways. This is doubtless the usual arrangement of atoms (see fig. 138), and shows how it is that the sun does not become exhausted, as it is able to receive the ethereal forces of all kinds from all quarters of the heavens, including planets, comets, stars and nebulous matter at the same time that it is transmitting the same to all quarters in return. Thus is easily settled a great and troublesome difficulty which has ever been arrayed against Isaac Newton and others who advocated the emission theory of light, as it scarcely seems to have entered the conceptions of people that the sun could *receive* as well as *give*. "May there not be in the heavenly regions," says La Place, "another fluid besides light? Its resistance and the diminution which its emission produces in the mass of the sun,

the atmosphere will gradually be withdrawn by chemical processes, and that then a time will come when the earth will have no atmosphere." I think my readers, however, need not worry for fear the atmosphere will fail them, unless they expect to live for several hundred thousand years yet. "It seem to me," continues the learned professor, "that the way in which man is consuming the vegetable supplies of the earth must have an end. When man, the inventor of so many machines which are using up the supplies of coal, when man insists upon using the materials of the earth at such a rapid rate, we begin to see our way toward an end." The Professor should remember that but a small part of the earth is now really cultivated; and besides this, statistics show that much that is cultivated is a perversion, several times more money and effort being spent to gain liquor, tobacco and other hurtful things than to gain food. The fact that coal and fuel are being used up rapidly for machinery, cooking, etc., should not give the least uneasiness, as any one who has looked into the fine forces of nature, will readily understand that far greater potencies are yet to be evoked from electricity, magnetism, sunlight, air, water and the finer ethers for heating, lighting, locomotion and driving machinery than the world now dreams of. Millerites and scientists who would thus destroy us before our time, just as we are getting ready to live, should remember that nature's general plan is to allow fruit and worlds to come to maturity before permitting the processes of destruction to commence.

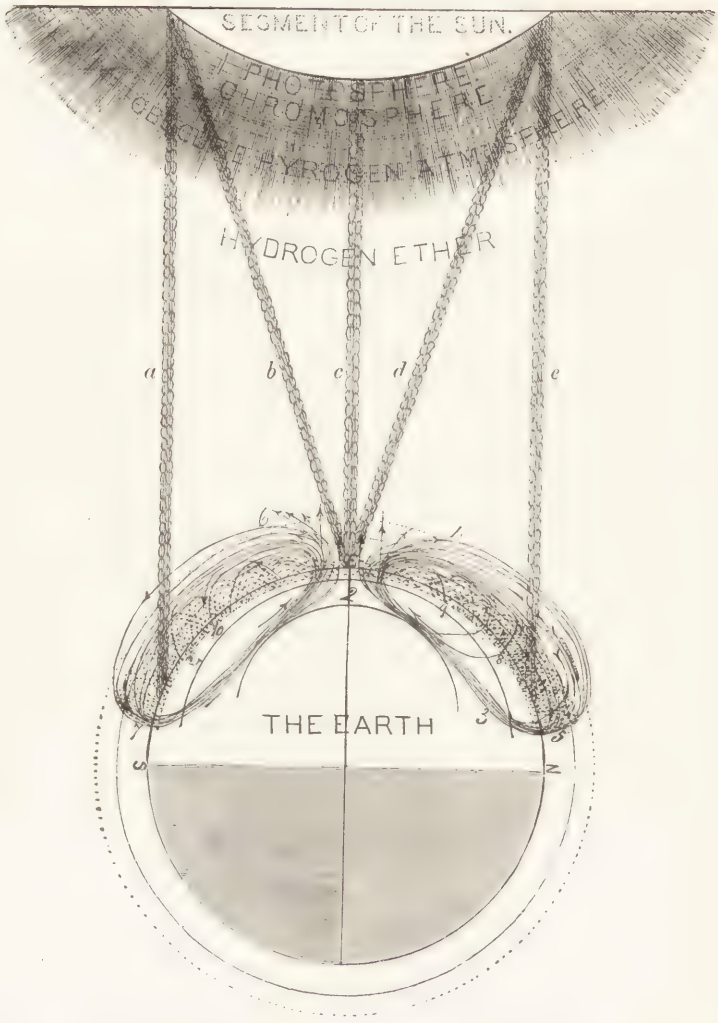


Fig. 153. The Sun, Earth and the Ethereal pathway of the Solar Ethers; *a*, converse lines of atoms polarised and traversed by Solar ethers between the sun and earth: *b*, converse lines of another layer of atoms arranged obliquely; *d*, converse lines of still another oblique layer of atoms; N. North Pole; S. South pole; E. Equator; 1, 2, 3, layer of molton iron beneath the earth's surface; 5, North Magnetic Pole; 7, South Magnetic Pole; 2, 4, 5, currents of thermo electricity flowing northward; 2, 6, 7, currents of thermo electricity flowing southward. The dotted lines just below the earth's surface show layers of cooled iron while the magnetic curves issuing from them are shown by the curved dotted lines; 8, 9, 10, etc., show lines of thermo electricity are drawn into the earth by the magnetic currents, by means of which the magnetic needle is made to dip

ought at length to destroy the arrangement of the planets, so that to maintain this, a renovation would evidently be necessary." (System of the World, vol. ii. p. 332.) Just how this renovation takes place may be seen by this atomic law.

10. Such is the crystal pathway over which such boundless floods of luminous and other forces are transmitted through space, and such are the links on which all worlds are hung and by means of which the universe is held together. The tide of light which comes to us seems almost limitless, and yet our planet receives only a 2300 millionth part of the sun's power. It may be asked, how can light come to any given point of the earth from so many different directions as long as the lines of the cosmic ether in each layer of atoms must naturally lie parallel to each other or at least approximately so? This difficulty at once vanishes when we consider that there must be layers of atoms almost infinite in number pointing in every conceivable direction; thus one layer has polarized lines in the direction of *a*, *c*, *e*, another perhaps directly under it has all its lines parallel with *b*, another still under that in the direction of *d*, and so on. Thousands of these minute layers can strike the eye at once, and thus render visible objects in every possible direction.

11. *Gravitation* must be able to use these atoms and their ethers, as well as the atoms of much finer atmospheres which interpenetrate the cosmic ether, as pathways for its sublime movements, some conception of which we may gain when we realize the vortical suction of lines of atoms.

IX.—The Aurora Borealis (Northern Lights)

Has its culmination of power about the north magnetic pole, and, as in the case of meteors, gives its most brilliant effects in autumn. It is seen more and more vividly in proportion as the observer approaches the magnetic pole. It is preceded by a dingy appearance of the sky in the north, sometimes spreads out in a luminous arch of bluish white (see fig. 96), sometimes darts up *streamers* of light, sometimes expands into luminous ribbons, sometimes it flickers with radiations that are called *merry dancers*, and occasionally in the far north it widens over the whole northern sky like a cupola of fire sustained on vari-colored pillars. This phase is called the *Boreal Crown* or *Corona*. When the lights are

bright they sometimes assume the colors of green, purple, violet and rose. They have been estimated to extend from five to several hundred miles in height. But why do they appear at the north, and why do similar phenomena called AURORA AUSTRALIS, or SOUTHERN LIGHTS, appear in the southern hemisphere around the south magnetic pole? In order to understand this it will be necessary to explain something of the earth's electrical and magnetic forces, more of which will be given in the chapter on Chromo-Dynamics.

X.—TERRESTRIAL FORCES.

1. Fig. 153 will assist in understanding the earth's forces. It should be remembered at the start that in *thermo-electricity* (electricity generated by heat) *the law is, that unimpeded electrical currents always move from warm to colder regions. For this reason the great tendencies of the earth's electrical currents must be two-fold, 1st to move from the heated earth vertically into the cold atmosphere above, and 2dly, to move from the equator to the colder regions towards the poles, the electric current moving northward in the northern hemisphere, and southward in the southern.* It should be remembered also that electricity constitutes the cold principle as already abundantly shown and that from the law of atoms, cold attracts electricity just as heat excites and attracts thermism, hence the above rule. But why do not the electrical and magnetic forces in the northern hemisphere tend directly to the north pole instead of the north magnetic pole which is 11° farther south? Because the north magnetic pole is the centre of the greatest cold. Why? From the fact that it is located on land where the mineral action engenders the most intense electrical and magnetic currents, while the earth's north pole is evidently covered with water which is comparatively a poor conductor of electricity. Sir David Brewster was the first to prove that there are two special magnetic poles in our northern hemisphere, or two points of maximum cold in which the needle stands in a vertical direction, although there must be other points also where sufficient masses of iron exist to excite strong magnetic action. There are probably as many as two magnetic poles in the southern hemisphere also, one of which has already been discovered. Sir James Ross discovered one of the north

magnetic poles in 1830. It is north of Hudson's Bay in latitude 79° north and in longitude 96° 43′ west. This is the point towards which the electrical currents of a considerable section of the earth, including North America and vastly more, are ever tending, and these currents account for the direction of the magnetic needle which varies more and more from the true north as we go east or west of this meridian. This too shows why all sensitive and delicate persons sleep much more comfortably with their heads to the north, as abundantly demonstrated by Baron Reichenbach, for in this way the cool electrical forces move towards their heads instead of their feet. See Chromo Dynamics, XI.

2. In the figure, 4, 5 represents thermo-electricity as flowing northward in the northern hemisphere and 6, 7 as flowing southward in the southern hemisphere. The space 1, 2, 3, enclosed between two arcs of a circle represents the layer of molten iron below the crust of the earth which, being somewhat light as a metal, cannot be located so far towards the centre of the earth as the heavier metals, such as copper, lead, gold, silver, platinum, etc.,* Above this line nearer the surface of the earth are the metals which have been thrown up by volcanic action and cooled off. The most abundant of these is iron which being spread out over the whole crust of the earth I have represented by the dotted line, just below the surface. We have seen what causes the thermo-electric currents which must be strongly of the magneto grade of electricity as they sweep the magnetic needle towards the poles (i.e. the magnetic poles). But what is the cause of the earth's magnetism? Iron is the natural element of magnetism and when electrified becomes magnetic. The molten iron 1, 2, 3, however, cannot be magnetic, as heat destroys the magnetic curves. The cooled iron nearer its surface then must be its generating power. But how can nature impart electricity to this iron? Under the head of Galvanism (Chap III,

*I have represented the iron in the figure as being thinner in its mass at the equator then at the poles. All the interor metallic and heavy substances being in a molten condition must be thrown nearer to the surface at the equator than at the poles by the earth's axial motion, which at the surface there, is a thousand miles an hour. The abundance of volcanic action in the torrid zone, argues in the same direction, as the melted matter underneath forces its way more easily through the thin crust near the equator.

XXXIV),we have seen how different metals connected by acidulated water joined by a wire to complete the circuit, at once arouse electricity. It is well known too, as Faraday proved, that an alkaline substance combined with the water, will also excite the electric current. Now in the earth, above and below iron, are various metals and substances which will generate and conduct electricity, and the moisture which everywhere saturates the earth, in connection with such alkaline substances as lime magnesium, potassium, etc., are admirably suited to develope electrical action over the crust of the earth and especially in connection with the iron. This makes the earth then a continuous battery and sets into action countless magnetic curves extending all the way from the equator to each magnetic pole. These curves may be from inches to miles in length, and must grow higher and steeper as they approach the great electrical action of the poles. I have given a rude representation of some of these curves in the heavy dotted lines of the cut. At the equator the heat is so great as to pretty much destroy these curves. We may now explain the mystery of *the dip of the magnetic needle.* It is well known that the needle points to the magnetic pole, or is arranged in what is called the magnetic meridian, yet if so hung as to be free to move up and down as well as towards the north and south, the north pole will dip towards the earth in the northern hemisphere and the south pole the same in the southern hemisphere. At the magnetic poles the needle stands perpendicularly to the earth, showing that a very steep or vertical electrical current is sweeping into the earth, but its inclination averages less and less until the equator is reached where the needle is mainly level. The dip undergoes some changes from year to year, owing doubtless to changes in temperature or contact with nebulous conditions, etc. In London in 1723, the dip reached an inclination of 74°+42′ while in 1871 it was only 67°56′ 3″. In Peru it is 0° ; in Cape of Good Hope 34° ; in Gottingen 68°22′52″; in Edinburgh 71°37″ ; in New York 73°14′ ; in Hudson's Bay between 89 and 90°. What is the cause of this ? At a distance, for instance, not very far north of the equator the magnetic curves must rise but little above the earth's surface, and directed by northward currents of thermo electricity must pass northward and enter the earth with a feeble slope. As this passes through the air and enters the earth, it

must deflect some of the thermo-electric and atmospheric electric currents with it and so carry the northward end of the needle somewhat downward as seen in 8, 9 etc. of fig. 153. Farther north where the curves become more intense and steep from the cold, or possibly from the great masses of underlying iron, the needle must dip still more, while at the magnetic poles, see 5, the curves must become almost perpendicular and drawing in some of the thermo-electric currents cause them to penetrate deeply into the earth until they strike the molten iron 3, and pass southward. As it approaches the equator (2) where the iron is crowded out thin and pushed up near the surface by the heavier metals below under the earth's axial motion, the ascending electrical currents may be supposed to draw them outward into the air again, and so a complete circuit is formed through 2, 4, 5, 3, 2 just as in the southern hemisphere, the currents move through 2, 6, 7, 1, 2.

3. Do we not then have a key to these polar lights? Are not the arches which sometimes appear simply the result of magnetic curves sweeping through nebulous matter. Is not the red light which appears caused through incandescent hydrogen, the green light by incandescent floating particles of iron, carbon, oxygen and perhaps other substances whose combined spectra are strong in the green, blue, yellow, and so on? Is not this incandescence a necessary result of such powerful centres of electric and magnetic force when striking against masses of volatile matter? It should not be presumed that the aurora borealis appears only at the north magnetic pole, but rather northward, the electricity in that direction through the northern hemisphere being greater than it is southward, though its culmination is at the pole, of course. As proofs, then, that these polar lights are caused through electrical and magnetic action, we have the fact 1st, than the magnetic needle is always greatly excited at their occurrence, sometimes varying many degrees from its ordinary position; 2dly, similar phenomena have been repeatedly produced by electricity artificially; 3dly, their greatest power is at the magnetic poles; 4thly, the magnetic poles as we have seen are the greatest terrestrial centers of electricity and magnetism. These and several other reasons seem to settle the matter conclusively, especially when viewed in the light of atomic and chemical action already explained.

4. Why is it that the aurora borealis appears in its highest brilliancy in the autumn unless it be that the nebulous matter which is ever revolving around the earth becoming condensed by the change from warm to cold, falls sufficiently low about the north pole to receive the play of the magnetic and electric forces? Why is it that meteors are also most abundant in autumn, if portions of this same nebulous matter, becoming condensed in the same way, are not sent through our atmosphere by their increased gravity?

XI. The Solar Atmosphere.

1. The heat of the sun is so immense that all of its metals and other substances become intensely incandescent on its surface, or exist in the form of luminous vapors for thousands of miles from its body. Prof. Tyndall, in harmony with the opinions of Mayer, Kirchhoff, etc., describes it excellently as follows:— "Without doubt the whole surface of the sun displays an unbroken ocean of fiery fluid matter. On this ocean rests an

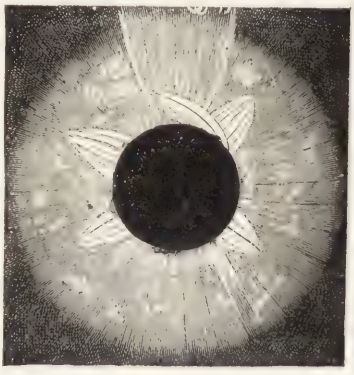


Fig. 154. Eclipse of 1858 (Liais).

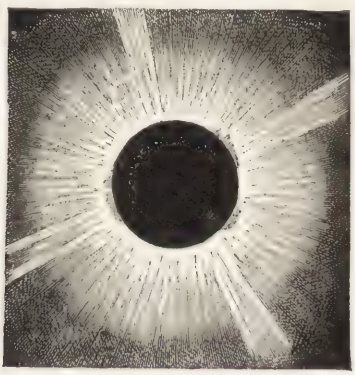


Fig. 155. Eclipse of July 18, 1860, (Feilitzsch).

atmosphere of glowing gas—a flame atmosphere, or photosphere. But gaseous substances, when compared with solid ones, emit, even when their temperature is very high, only a feeble and transparent light. Hence it is probable that the dazzling white light of the sun comes through the atmosphere from the more solid portion of the surface."

2. "The spectroscope," says Prof. Roscoe, "is the instru-

ment by which the extraordinary phenomena of physics have been revealed, and the first step towards the extension of our knowledge has been the examination of the light emitted by those remarkable protuberances, or red flames, which, during a total eclipse, are seen to dart out from the surfaces of the sun to the enormous height of some 80,000 to 90,000 miles. * * * Lockyer's investigations have not only proved that these singular prominences consist of glowing gaseous hydrogen, but have revealed the existence of an atmosphere, chiefly consisting of incandescent hydrogen, extending all round the sun's surface. The prominences are only local aggregations of this local envelope of glowing hydrogen, which extends for 5000 miles in height, and has been termed the *Chromosphere,* to distinguish it from the cooler absorbing atmosphere on the one hand, and the light giving photosphere on the other." During a total eclipse of the sun vast luminous projections called corona make their appearance, as seen in figs. 154, 155, and 156. These figures would seem to suggest opposite polarizations of force on different sides of the sun.

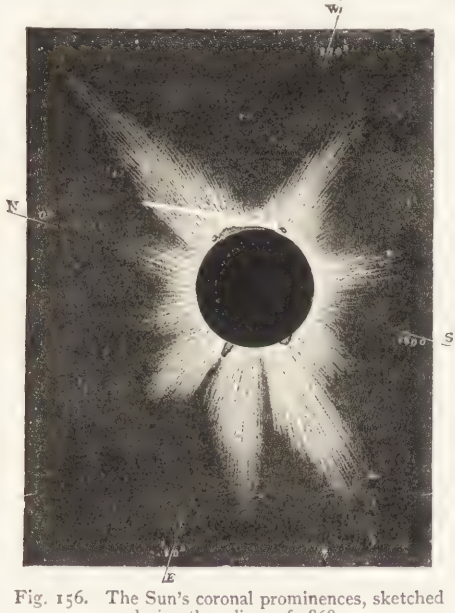


Fig. 156. The Sun's coronal prominences, sketched during the eclipse of 1868.

3. The movement of this luminous hydrogen, when wrought up into the terrific hurricanes which frequently take place in the sun's fiery atmosphere, is something fearful to think of. Lockyer discovered by his spectroscope gales which moved from 40 to 120 miles per second, or about 3600 times as swiftly as an earthly hurricane, while Prof. Young, of Dartmouth College, saw a mass of flaming hydrogen move upward over 200,000 miles from the surface, 100,000 miles of which was traversed in 10 minutes, a velocity about 600 times as great as that of a cannon ball! And

yet some have been so absurd as to suppose the sun to be the abode of certain spiritual intelligences, while others have gone so far as to declare that even human beings dwell there, although the heat and fearful play of forces must be great beyond all conception, or measurement of earthly instruments.

4. The metals that exist in the luminous atmosphere of the sun have been examined by Lockyer, Huggins, Ångström, Young, etc., by means of the spectroscope, and thus far have been found to be 17 in number as follows :

1. Sodium.	5. Iron.	9. Zinc.	13. Hydrogen (gas).
2. Calcium.	6. Chromium.	10. Strontium.	14. Manganese.
3. Barium.	7. Nickel.	11. Cadmium.	15. Aluminum.
4. Magnesium.	8. Copper.	12. Cobalt.	16. Titanium.

17. Rubidium.*

5. The materials of the sun itself, as well as of the planets, must be the same as those of our own world, all having had a common origin as we have already seen.

6. Andrew Steinmitz, Esq., of the Middle Temple, London, says :—" We can no longer consider light as merely consisting of infinitessimal *particles*, or as infinitessimal *waves;* we may now conclude that it is *metallic;* that sunshine consists of a metallic shower ; the beneficent sunshine bathes us with elementary iron, sodium, magnesium, calcium, chromium, nickel, barium, copper, zinc and hydrogen." But metal which can thus float in sunbeams is incomparably finer than that which lies in hard masses in the darkness of the soil.

7. The following are the sun's outer conditions, commencing with the most refulgent (See fig. 153) :—

1st. The *luminous surface* of the sun's body.

2d. The *Photosphere,* or heavy flame-atmosphere of vaporized metals, as well as oxygen, hydrogen and other gases.

3d. The *Chromosphere,* extending some 5000 miles beyond the photosphere, and consisting of the atmosphere of red incandescent hydrogen, combined with finer and more ethereal elements of metals than those of the photosphere.

* Since writing the above, the Journal of the Franklin Institute has given Prof. Draper's paper, read before the American Philosophical Society on July 20, 1877, in which he announces the discovery of oxygen, and probably of nitrogen and other elements, in the solar atmosphere, by means of photography, their spectra being designated by bright instead of dark lines, as in the Fraunhofer scale.

4th. The *Obscure Hydrogen Atmosphere* still farther outward than the Chromosphere. This is doubtless more or less incandescent, and yet without a sufficiency of gross matter to be visible to us.

5th. The *Cosmic Ether* or more ethereal hydrogen, which becomes finer and finer as it extends outward into space to form the pathway of the solar and other fluid ethers.

XII. Faculæ and Spots on the Sun.

1. Sir William Herschel supposed the body of the sun to be a dark mass surrounded by a luminous atmosphere, through the openings of which at times the dark surface would appear. Kirchhoff showed the incorrectness of this theory, as the interior of the sun must be white hot, and concluded that these spots were clouds floating in the solar atmosphere. We have seen that there are tremendous commotions and tornadoes in the atmosphere of the sun, and we may well suppose that the body of the sun itself must be subject to great volcanic eruptions and perturbations. What are called *faculæ*, or *bright spots*, seem to be caused by some volcanic action, as the spectroscope reveals an *upward movement* of "incandescent, vapors of sodium, iron, magnesium, barium," etc., attended with great luminosity. Near these *bright spots*, or closely connected with them, are the *dark spots*, sometimes called *maculæ*, and these are generally seen *descending*. Is it not evident that these masses of partially opaque matter are the clouds of substance thrown up for some time in continuous luminous columns which we call faculæ, and that these clouds, by reaching the upper atmosphere, become cooled off and consequently dark? Is not the fact that they float along the sun's disc with a gradually descending motion proof that they have become condensed by the cold, and so are carried downward by their own gravity? Lockyer describes a cloud of incandescent magnesium that he saw floating high above a prominence, and the whole phenomena of these faculæ and maculæ seem easy of explanation by inductions which we may draw from the revelations of the spectroscope.

2. When viewed with a telescope the sun is observed to be mottled over its whole surface with small *dots* or *pores* which when carefully watched are seen to be in a constant state of change. These are probably smaller masses of vaporous matter

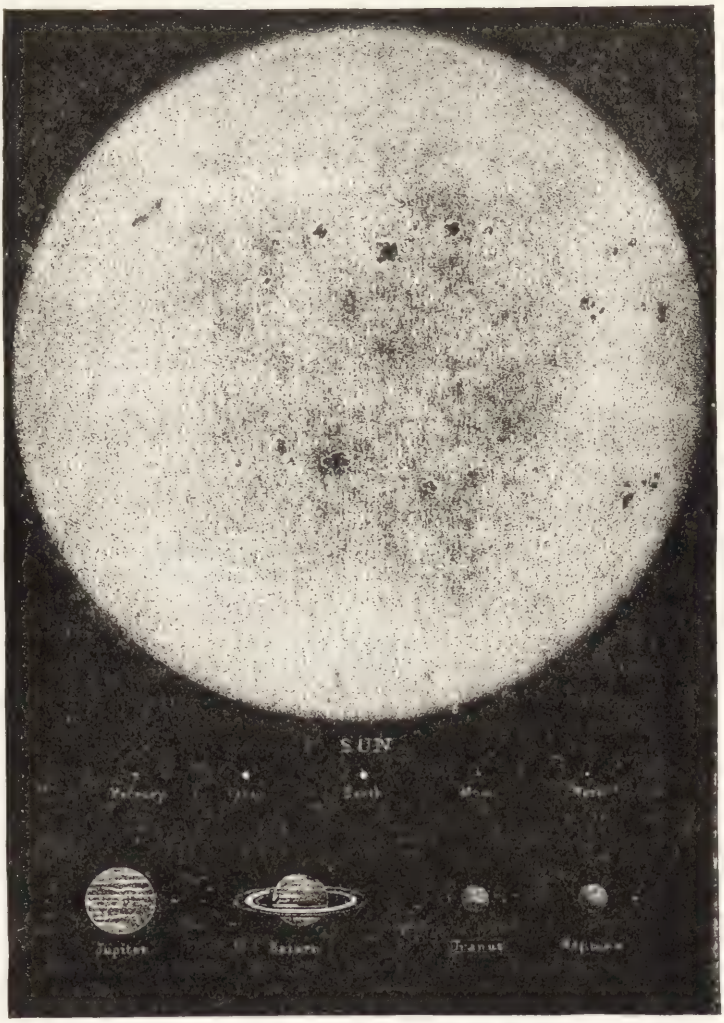


Fig. 157. Comparative sizes of the Sun and Planets after Guillemin, with a view of some of the spots and mottled appearance of sun.

which have risen upward and become cooled and darkened, and which then by their increased density sink again to become heated and rarified before going through the same process.

XIII. Solar Statistics.

Some of the following statistics are given according to Prof. Young, the well known astronomer of Dartmouth College, and others are in harmony with the figures of general astronomical science. The diameter of the sun 860,000 miles; size 1,280,000 times that of the earth; average density, one-fourth that of the earth; Weight over 2,000,000,000,000,000,000,000,000,000 (2 octillions) of tons, or nearly 750 times as great as that of all the combined planets and asteroids; mean distance from the earth about 92,250,000 miles; distance on Jan. 1st, 90,750,000 miles, or 3,000,000 miles nearer than in summer; the weight of any substance at the sun's surface is 27½ times as great as it would be on the earth. The sun revolves around its axis in 25⅓ days, and moves through space, according to Struve's estimate, with all its family of worlds, about 412,000 miles per day, but in reality probably far more rapidly, judging especially from some similar orbs in our system. The number of worlds so far discovered include 8 as ordinary *planets*, 22 *moons* and 106 *asteroids*, a very minute class of worlds probably of a fragmentary nature, and revolving between Mars and Jupiter. So our sun, with ts family, must be a pretty large and heavy pet for Alcyone to carry through space, and yet quite diminutive compared with many of its starry mates. Prof. Proctor asserts that Sirius, sometimes called the Dog Star, is 5,000 times the size of our sun.*

XIV. Sun Power.

1. If the sun is thus able to vaporize the coarse and heavy metals and hurl them thousands of miles into space, how much more easily may it be supposed to propel the exquisitely fine and elastic ethers through untold millions of miles to our earth and to distant stars, especially when aided by the vortical suctions of the cosmic ethers. But many persons think of the sun's rays as having all the power which they awaken, in themselves, aside from the objects with which they come in contact. *It is a well known fact that these rays have almost no sensible heat in passing through*

* Prof. Hall of the Washington Observatory, by the aid of the great telescope, has discovered 2 minute Moons of Mars, which I have included in the estimate, and as new asteroids seem to be discovered every year, the table must from time to time receive some modification.

our atmosphere, but owe their great effect to their impact upon, and chemical affinity with, the elements of our earth. If they strike the earth vertically and for some time continuously as in the torrid zone, the earth becomes greatly heated, and by convection and somewhat by radiation, the atmosphere becomes heated thereby. If they strike the earth obliquely, as in the frigid zones, only a small number of rays comparatively reach the soil and the chemical action is too feeble to produce much heat. If they strike the summit of a high mountain, even in the torrid zone, they are unable to impart much sensible heat, 1st because the great mass of atmospheric strata which are heated by convection are much below this, thus leaving the summit far up in the colder electrical strata; 2dly, the form of the mountain receives most of the rays obliquely, and 3dly, the summit being above most of the clouds, there is nothing to shut in the reflected rays and hence they are lost in space.

2. General Pleasonton gives extensive space in his work on "Blue and Sun-Lights," to the advocacy of the strange fancy that the sun is not the source of heat to the earth, because he discovers that the heat is not perceptible in coming through the atmosphere, that high mountains are cold, even in warm regions, etc. But on the same principle, neither is the sun the source of light, for as will be shown in the next paragraph, without the aid of solid particles in our atmosphere, it might beam on us a thousand years and we should still be in total darkness.

3. But here as usual we must combine the duality of action and reaction, of fluid and static elements, before we can get the beautiful effects of nature. Even Tyndall in the following sunburst of eloquence concerning the sun, has seemingly, for the time being, forgotten this principle:—"He rears the whole vegetable world and through it the animal; the lilies of the field are his workmanship, the verdure of the meadows and the cattle upon a thousand hills. He forms the muscle, he urges the blood, he builds the brain. His fleetness is in the lion's foot; he springs in the panther, he soars in the eagle, he slides in the snake. He builds the forest and hews it down, the power which raised the tree and which wields the axe being one and the same. The sun digs the ore from our mines, he rolls the iron, he rivets the plates, he boils the water, he draws the train. He not only

grows the cotton but he spins the fibre and weaves the web. There is not a hammer raised, a wheel turned, or a shuttle thrown, that is not raised and turned and thrown by the sun. His energy is poured freely into space, but our world is a halting place where this energy is conditioned.* * The sun comes to us as heat, he quits us as heat, and between his entrance and departure, the multiform powers of our globe appear." I would not unnecessarily criticise the words of this masterly exponent of experimental science, but it seems to me that the foregoing will tend to mislead, as it evidently gives the sun a greater share in all the matters named, than the earth, which is untrue. The sun is simply the positive principle and the earth the negative, neither of which could do any of these things without the other. We have seen that without the earth's co-operation we could get no sensible heat or light from the sun. We can gain powerful solar ethers however, with which the terrestrial elements may unite to produce the effects of heat and light.

4. Following the same style of reasoning as the above the distinguished physiologist Dr. Carpenter says that "Spirit is the sole and single source of power." And yet not a thought, or feeling, or aspiration or inspiration can ever come to us in this life, aside from a physical brain and body as the negative principle, in connection with which all spiritual action must take place, while in the next life the "spiritual body," of which St. Paul speaks, may constitute the finer negative principle there, in connection with which the spirit must act. (See Chap. Second, XIV—XVIII.) It would be correct to say that spirit is the positive principle of power, or the sun is the positive principle of power, and would not mislead, for then we should understand that there must be some negative principle without which no action could take place. I dwell so much on these dual correlations of things from the fact that they are so widely misapprehended. When Tyndall says "the sun comes to us as heat, he quits us as heat," the expression is a little careless, as the solar ethers come to us partly as heat and partly as cold or electricity, although the electrical rays probably arouse a greater heat after they get here by means of chemical affinity, than do the thermal rays themselves.

XV. The Production of Light.

1. After traveling through this long pathway of principles and facts, I think we have the way prepared, at last, for quite a complete apprehension of the method by which light is produced.

2. *How does the sun produce the effect of light upon the earth?* It has been shown by experiment, that the solar ethers hurled through our atmosphere, are not able of themselves to produce a grade of light sufficiently compact for our vision to take cognizance of. The following from William Spottiswoode, F. R. S. is in point:—"What produces the effect of light from all parts of a clear sky? The sky is pure space, with no contents save a few miles of atmosphere of the earth, and beyond that, the impalpable ether, supposed to pervade all space and to transmit light from the furthest limits of the stellar universe. The ether is, however, certainly inoperative in the diffusion of light now under consideration. But a very simple experiment will suffice to show that such a diffusion, or, as it has been better called, a scattering of light, is due to the presence of small particles in the air. If a beam from an electric lamp or from the sun be allowed to pass through a room, its track becomes visible by its reflection from the motes of floating bodies, in fact by the dust in the air. But if the air be cleared of dust by burning it with a spirit lamp placed underneath, the beam disappears from the parts so cleared, and the space becomes dark. If, therefore, the air were absolutely pure, and devoid of matter foreign to it, the azure of the sky would no longer be seen, and the heavens would appear black; the illumination of objects would be strong and glaring on one side, and on the other their shadows would be deep and unrelieved by the diffused light to which we are accustomed. Now beside the dust there are always minute particles of water floating in the atmosphere. These vary in size from the great rain drops which fall to earth on a sultry day, through intermediate forms of mist and of fine fleecy cloud, to almost invisible minuteness. It is these particles, whether of water or other matter it is perhaps difficult to say, which scatter the solar rays and suffuse the heavens with light. And it is a remarkable fact established by Prof. Tyndall, while operating with minute traces of gaseous vapors, that while coarser particles scatter rays of every color—in other words scatter white light—finer particles scatter fewer rays from

the red end of the spectrum, while the finest scatter only those from the blue end. And in accordance with this law, clouds are white, clear sky is blue." (Polarization of Light, p. 82).

3. *Tyndall, Brücke,* and other scientists give accounts of experiments in which different particles of floating matter tend to produce different color effects, and are of the opinion that the bacteria or infinitessimal insects that exist so abundantly in the atmosphere, especially in that which is warm, add very materially to the illuminating effect. This is doubtless true, as these animalcules are endowed with the special activities that belong to life. Tyndall and others show that the finer particles of matter tend to induce the colors of the violet end of the spectrum, while the coarser induce those of the red end. This is doubtless correct as we have already seen, so far as it applies to the ethers which constitute the material portion of colors. Prof. Lommel and most other scientists admit that ordinary coal gas, oil-lamps, etc., owe their principal luminosity to ignited solid particles of carbon. But what are the solid particles of the atmosphere which are thus kindled into light as the solar ethers sweep through them. To answer this we must look somewhat into the

XVI. Constitution of the Atmosphere.

1. The usual composition of the atmosphere, as given by chemists, is as follows:—

Oxygen (slightly magnetic)	number of per cent	20.61
Nitrogen (diamagnetic)		77.95
Carbonic Acid (CO_2)	a chemical combination	.04
Aqueous vapor (H_2O)	" "	1.40
Nitric acid (N_2O_5)	" "	Traces.
Ammonia (NH_3)	" "	
Carburetted Hydrogen (CH_4)	" "	

2. But we have seen (VII, 3) that nearly, if not quite every substance of the earth is floating in a refined form through the atmosphere, as shown by Tissandier, Nordenskica, and by deductions from the general laws of matter. We see by the above that while oxygen and nitrogen are the ruling elements of the atmosphere, carbon, as in the carbonic acid, and hydrogen as in the vapor, and ammonia and marsh gas or carburetted hydrogen are also ingredients. Hydrogen being the *champion heat atom*

of the world, must be the enkindler of flame and a great promoter of incandescence and luminosity in the contiguous atoms. *Sodium* is also revealed by the spectroscope as an ubiquitous element of the air. "There is not a speck of dust, or mote in the sunbeam," says Prof. Roscoe, "which does not contain chloride of sodium (salt). Sodium is a prevailing element in the atmosphere, we are constantly bathing in portions of this elementary substance together with the air which we inhale. Two thirds of the earth's surface is covered with salt water, and the fine spray which is being carried up into the air evaporates, leaving the minute specks of salt which we see dancing in the sun." This sodium among other elements has a grand mission to fill for when ignited, constantly gives out yellow light, the central principle of luminosity, by which the universe is revealed. Under the head of Chromo-Dynamics, definite facts will be given to show that all objects throw off their volatile elements into the atmosphere. So we have the oxygen as a prominent principle, giving off when ignited, as shown by the spectroscope the blue, red, violet, yellow, indigo, green, etc., and most abundant of all the nitrogen, which gives more or less of all the colors, and other gases.

3, But fine ignited gases are not sufficient except when highly compressed as in chemical combinations, to give out light for practical purposes, and consequently it is necessary to have solid particles or chemical compounds including carbonic acid, sodium, chloride, etc., to help in the process of lighting the world. These particles when struck by the solar rays, or by artificial light, become ignited and constitute diminutive fire-balls which may be called *luminelles* (little lights). These luminelles may consist of hollow globules of vapor, molecules of carbonic acid, or perhaps larger masses consisting of several molecules of different solid substances, or the bacteria before spoken of.

4. *Frankland* has endeavored to prove that there is no glowing solid matter necessary for the production of light, simply because he can place gases under a pressure of ten to twenty atmospheres, and cause a light which one can read by. Of course a large number of atoms or fiery particles in a given space would be more luminous than a small number. But ordinary light is produced under no such compression. He says the light of coal

gas or candles is not produced by solid particles of carbon, but "by the ignition of highly condensed gaseous hydrocarbons." He may call them *gaseous* if he pleases, but these gases must have countless luminelles, as will be shown by millions of black particles which gather on a brass or a silver knob held in the flame for a few moments. The luminelles which float in the atmosphere at an ordinary heat and pressure must be much more minute and refined than these carbon luminelles of the flame, for they are ignited or cooled off by the solar ethers instantaneously, and their heat is usually so soft as to give no painful impression to the eye or to the skin as it falls upon us. But just how are luminelles set on fire so as to afford us light and color of various kinds? Before considering this we must learn

XVII. How Color Effects are Produced.

1. We have already seen in Chapter Third, how different colors are formed by different sized spirillæ in connection with the different grades of ethers which pass through these spirillæ. But what causes gold to appear yellow, or coal black, or snow white, for instance? Gold is yellow because it has a spirilla of the right grade to *repel* or *reflect* the yellow-forming ether while it has other spirillæ which receive the other color ethers more or less within themselves and thus hide them. If all of the spirillæ had such an affinity for the other color-ethers, and their atoms could become polarized in such a way that these ethers could be transmitted entirely through them, it would be transparent like the air or nearly like clear glass. If its spirillæ should briskly repel all of the color-ethers into our eyes it would give us the effect of *white;* if they affinitize with them sufficiently to draw them all within its surface, the effect would be *black*; if they should absorb a part of each color-ether and reflect a part, the effect would be *normal gray;* if a majority of each color-ether is reflected, *light gray* would result, and if a majority absorbed, *dark gray* would appear. If the red and part of the other colors should be reflected it would cause red-gray, and the same principle applies to the other grays. If nearly the whole of the red or the blue should be transmitted, while the other colors were absorbed, reflected, or slightly transmitted, we should have the

effect of red-glass, or blue-glass, or any other colored glass according to which color predominates.

2. Let us see, then, how rays of luminous ether can produce the effect of light. Take the yellow ray, for instance, the center of luminosity. Sodium, magnesium, iron, and other substances, when under the terrific heat at or near the burning surface of the sun have a tremendous repulsive action upon all yellow-forming ethers including fine particles of their own substance, and project them into space. Before getting entirely away from the solar atmospheres, however, the coarser part of these ethers is strained off while the finer part proceeds through space and strikes our atmosphere. According to the principles of chemical affinity already explained (Chapter Third, XXXVII, 10), the atoms of both nitrogen and oxygen must have an especial affinity for the principal yellow-forming ethers, as they are strong in violet, and thus become ignited as they pass through, aided in this ignition by proximate particles of hydrogen, which are so quick to take fire, and which constitute an ingredient of vapor. So far the globules of vapor are the principal sources of light, but that is not sufficient. All luminelles of materials like themselves, such as sodium, magnesium, etc., must be repelled at their touch, ignited by their impact against them, and many of them driven on to the earth before their power. Violet-colored luminelles having a chemical affinity for them will transmit them freely and become incandescent thereby, and luminelles of various colors will be met and penetrated in the same way, for, as Isaac Newton has shown, all styles of matter, however opaque or however colored, become more or less transparent to light, in case they are in very minute masses. The same principle holds true with reference to the other color-forming ethers, the violet ethers sweeping with special ease through luminelles of sodium, magnesium, etc., in which yellow is active, the blue ethers sweeping with especial ease through the hydrogen of vapor luminelles, in which the red principle in the spectrum is active, as well as through many other substances, such as carbon, lithium, nitrogen, etc., and so on with all the other colors, each of which drives before it certain ethereal atoms like itself in a common tide to the earth, and each does its part in setting the whole atmosphere on fire and thus filling the world with light.

XVIII. Shadow is an Entity.

1. Shadow is supposed to be the absence of light, just as cold is supposed to be the absence of heat, and just as black was formerly, and is sometimes yet called the absence of color. We have seen in Chapter Third, that cold is as distinct a law of motion as heat, and we have seen also that, although black is caused by the absorption of all the color ethers, it is caused practically, as seen in the union of pigments, by the combination of all colors, only in a different proportion from that required to form white.

2. We shall find that *there are no nihilities in the universe*, no vacuums; even *space* and *time* being the measurement of extension and of duration in the abstract, while considered concretely, space is filled with ethers, nebulæ, comets, suns and worlds, and time is the everlasting succession of events.

3. Again there is no such thing as *absolute silence* or *absolute rest* in the known universe, for all that these terms can signify when philosophically considered, is that the infinity of vibrations, pulsations, waves, and movements which are in ceaseless operation everywhere, have simply subsided sufficiently not to affect human sensation, possessing too great a degree of fineness or coarseness to be perceived.

4. Another of these negative conditions is *shadow, which is simply darkened or cooled off luminelles*, already described. These luminelles or atmospheric particles, when struck by luminous ethers from the sun, or from artificial light, immediately become ignited and luminous, but when a screen is interposed to shut off these rays, there is not sufficient action among the particles to keep them incandescent, and a darker appearance which we call shadow is the result. In the day time this shadow is but feeble, as reflected light from all quarters keeps them more or less luminous. In the night, however, when the reflected light is small, the luminelles become much more cooled off, and consequently the shadows are much deeper. When a very brilliant light is used, like the calcium or magnesium, the shadow seems darker by contrast with the light. The black luminelles, such as those of carbon, are perhaps a more decided principle of shadow than the lighter colored ones when they are but slightly kindled into action. Under the head of Chromo Chemistry (XX., 21), I

shall show how these darker luminelles can be photographed upon chemically prepared paper as well as luminelles and ethers of different colors.

XIX. The Moon.

1. Our satellite is known by astronomers to be what is called a *dead world*, from having cooled off too much to sustain an atmosphere or other necessary conditions for human life, and yet it is an important source of light. Although it has nothing to *live* for within itself, it kindly holds up its burnished shield to the sun, and reflects all the luminous rays it possibly can upon our world, thus giving us many a night of soft and subdued brilliance. Its size is about 49 times less than its parent earth, and its mean distance from us about 240,000 miles, or more exactly, as determined by Prof. Adams, 238,793 miles. It moves through its elliptical orbit around the earth from west to east about thirteen times every year, and is so one-sided as to hold the same face ever towards the earth, having some special reason for not showing its other side. Judging by analogies it must have been cooled off, refined and inhabited by intelligent beings, vast ages before such a process could take place on our larger earth, possibly before our world left its crude sun-condition. Does it make us sad to think how the moon's people must have suffered with cold during the ages in which it was cooling? It need not, for nature, working ever on the law of kindness, easily adapts man for the changes necessary to a planet, until the interior of the planet itself becomes cooled to a certain extent, when in an instant, the whole is exploded and nobody is hurt. Nobody is hurt, simply because life is taken too quickly for any sensation to be produced, and the planet ceases forever to be the home of immortal beings. That the moon is an exploded or fragmentary orb, some fully believe, and it may be profitable to spend a moment in considering *how a world naturally comes to its end.*

2. We have seen (X. 2 of this Chapter,) that there must be a large layer of molten iron, at some distance below the surface of a planet, that above this must be a still lighter mass of minerals and earths which are molten and form the matter for volcanoes, while above this still, is the cooled off crust, including large masses of cool iron, which constitute the basis of magnetic

action for the whole planet. We, of course, do not know how thick the layer of molten iron must have been in the moon, but being the most abundant of metals we are probably safe in putting it at 100 miles, the whole distance from the surface of the moon to its centre being 1080 miles. What would be the effect now if this metal, which in its crude state is carburetted and brittle, should cool off and crystallize into a solid condition more rapidly on one side than on the other? What is the effect when cold and heat are brought unequally upon glass, but to burst it into pieces? My opinion is that the lower portion of this iron layer must cool off faster than the upper as the powerful magnetism of the earth's crust must generate an immense amount of heat over the whole outer portion of the earth by arousing the chemical affinities of all surrounding elements. This would make the interior part of the layer expand faster than the exterior, for iron is one of the metals that expand as they cool off and crystallize. The rupture of such a vast mass of iron in the moon, must have been inconceivable in its tremendous power, throwing portions of its globe into space to revolve as minute asteriods around the larger portion that may be left or possibly directly around the earth itself.

3. And now the reader may ask, is this the destiny of all worlds? Have you not told us that the progress of the universe is upward rather than, thus downward into ruin? Yes, forever upward, for what is thus seemingly a work of ruin takes place only after a world has accomplished its highest purpose under existing conditions, and is merely a process of changing its elements into that which is finer and better. Thus the moon, under the impact of sunbeams, and under the play of its own chemical and ethereal forces, is becoming more refined, eliminating its best elements into space, and wafting them, either directly to some other planet or to some distant nebulous mass where it shall eventually be crystallized and aggregated into a more beautiful world.

4. We may see then why it is that the moon always presents the same side to the earth. One side of its mass and its interior molten part being blown away, it must have a heavier and a lighter side. The earth's gravitation must hold its round and heavier side unchangably toward itself otherwise why does it not revolve on its axis and show its various sides, as is done in all other known worlds? I have not seen any attempt on the

part of astronomers to explain this phenomenon, but the above explanation, including its method of destruction, seems to me entirely rational. If the igneous central portion had been ejected into space, gravitation would at once draw the oceans into this centre and all things having become frigid, no clouds, or water, or atmosphere could ever more make their appearance upon the surface of the disabled world, which condition is found to be verified by astronomers.

5. Fig. 158 gives a condensed view of the *full moon* as seen



Fig 158. The Full moon.

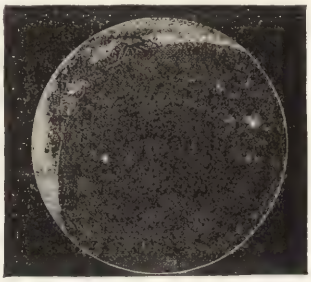


Fig 159. The Crescent.

through a telescope and fig. 159, of the crescent and what is called the *earth-shine* which is the dimmer portion that appears on account of the light reflected from the earth. Before the first quarter, when the half moon appears, this earth shine generally becomes invisible until the moon becomes small again.

6. *Eclipses of the Sun and Moon* and *Phases of the Moon* may be illustrated by fig. 160. In the first place notice that the greater size of the sun causes the earth and moon to throw diminishing shadows in the form of a cone some distance into space, the darker central portion of which constitutes what is called the *umbra*, the lighter portion the *penumbra*. Generally the moon in passing around the earth does not throw its shadow upon the earth or get into the earth's shadow, but sometimes it comes so exactly between the sun and earth, as in the position between 11 and 6, that it hides the solar orb and throws a dark shadow on the earth at 12, thus producing a total eclipse of the sun. At other times it comes into the range of the earth's shadow at 9, and we call it an eclipse of the moon. In most cases, however, when the moon gets around on the side of

the earth opposite the sun, as at 9, it does not enter the earth's shadow and shows its sun-lit side to persons standing at 3 or 4 as a *full moon.* In most cases also it does not hide the sun and cause an eclipse when it reaches the point between 11 and 6, but having its shady side next to us it becomes itself invisible. When it reaches 11 it begins to appear as a very new moon, at 7 we call it a quarter moon, at 1 a half moon and say it has reached its *first quarter,* at 8, it shows about three fourths of its size, at 9 it becomes a full moon, at 10 a three-quarter moon, at 2 a half-moon and has reached its last quarter, at 5, a quarter moon, at 6 it begins to fade out. The moon is sometimes said to be a *crescent* at 7 and 5, and is called *gibbous* at 8 and 10.

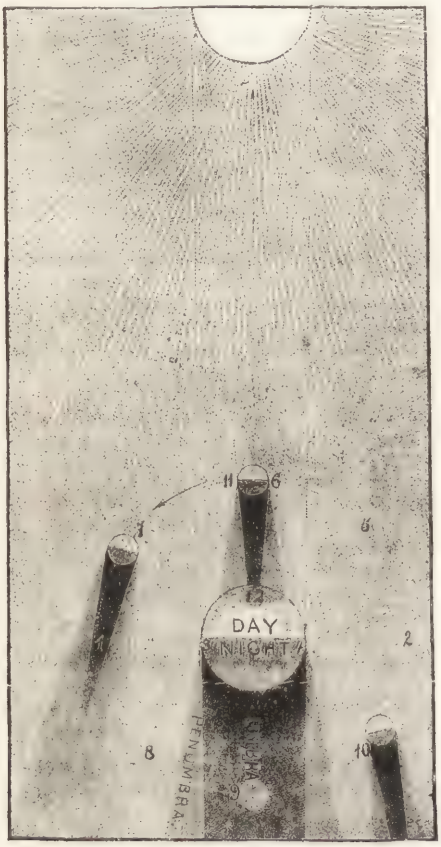


Fig. 160. Eclipses and Phases of the Moon.

7. The *Asteroids* which are generally considered by astronomers to be fragments of worlds, are doubtless portions of small planets which have cooled off and exploded in the same way as our moon.

XX. The Planets and Fixed Stars,

1. Though adding greatly to the cheerfulness of our nights, still all combined give but a feeble light as compared with that of our sun. The fixed stars are self-luminous and shine with a twinkling light. The planets shine with a steady and reflected light. Venus, sometimes the morning and sometimes the evening star, is the brightest of the planets to us, and Jupiter next.

Sirius, the brightest of the fixed stars, gives us, as signified by the photometer, 20,000,000,000 times less light than the sun.

2. The *Milky Way* under the revelations of the telescope, is presumed to consist of several millions of fixed stars, each of which is a vast solar system and one of which is our own solar system. But telescopes of great power reveal thousands of such clusters of stars, each of which is a Milky Way. Verily the mightiest imagination of man, can reach but a finger's length into the infinities of this universe! Looking at such a fact with a view of our present littleness, it is due cause for humility on our part. On the other hand, we may be exultant, for our souls kindled with the deific spark, must of themselves be among the grandest of all infinities, having capacities for mounting ever upward and onward through this very universe!

Fig. 161, will give William Herschel's earlier conception of the Milky Way or Galaxy. Assuming that the stars are about equally distributed, he concluded that the great mass of stars which appear in certain portions of the sky and which we call the Milky Way, result from viewing the cluster longitudinally instead of laterally. Thus if we stand at S which represents the position of the solar system in the Milky Way, and look in the direction of A or B or C, the stars must present a more dense appearance than they would if viewed in the directions of E, D or F. Later in life, however, he began to believe that the greater number of stars which appeared in certain directions may have resulted more or less from their being placed more closely together in certain directions than in others. Astronomers assert that all the stars in the whole heavens which appear to the naked eye belong to the Milky Way.



Fig. 161.
The Milky Way.

XXI. Combustion

Is intense chemical action attended with heat and generally with light, although physiologists sometimes speak of processes of combustion brought about by oxygen, etc., in connection with

animal life, when of course no light is evolved. *It can never be produced without combining some kind of electrical atoms like oxygen, chlorine, sulphur, etc., with some kind of thermal or alkaline atoms, such as hydrogen, carbon, potassium, magnesium, calcium, etc.* Oxygen has sometimes been called the supporter of combustion, but it would be quite powerless without some affinitive elements to draw out its action. Prof. Draper has well said that "no substance is, in itself, a supporter of combustion, nor is any one intrinsically a combustible body. If a jet of hydrogen will burn in an atmosphere of oxygen, so also will a jet of oxygen burn in an atmosphere of hydrogen gas." Thus we see again this ubiquitous law of duality as the ever recurring principle of all force.

XXII. Flame.

1. Flame always requires a gaseous combination of affinitive elements, and a thoroughly luminous flame must have an abundance of luminelles. The most practical of all substances, out of which luminelles may be formed, is *carbon*, 1st, because it exists abundantly in wood, forms nearly the whole of coal, much of oil, and a fair amount of illuminating gas, and 2dly, it is one of the most infusible of all substances, and consequently its particles retain their solid condition longest without becoming disintegrated. The constituents of ordinary flame, then, are hydrogen as the thermal, inflammable element, oxygen as an electrical substance to bring this hydrogen into full action, and carbon, which is also vitalized by the oxygen and whose particles are of the right size to constitute luminelles. These luminelles are eliminated from the solid mass by the aid of the combined oxygen and hydrogen, and being larger than any particles connected with these two gases, produce a far greater illuminating power. These elements constitute a hydrocarbon, or a compound of corbonic acid gas (CO_2) and hydrogen. "Is not flame a vapor, fume or exhalation," says Isaac Newton, "heated red-hot, that is, so hot as to shine?" A lighted lamp or candle is a kind of a gas factory, as a flame cannot be kindled until more or less of gas has been generated, and whenever a flame sways about it is simply the movement of gases whose luminelles have been made red-hot or yellow-hot by the rush of chemical forces. I say

yellow-hot, but if the action becomes sufficiently intense, so that the heat shall be great, they will become white-hot, or nearly so, as in the case of a calcium light. Thus the flame of a candle, as compared with that of the hotter gas, seems yellow, with some reddish tint, and the gas, as compared with the calcium light, presents the same appearance, while the sun light is still whiter than the calcium light. In the ordinary illuminating or coal gas, the hydrogen, carbon and other substances are already manufactured into gas, and hence the ease with which a brilliant flame is produced.

2. An ordinary *flame of a candle, lamp or gas*, consists of three layers, as shown in fig. 162; a blue electrical flame at the bottom where the oxygen of the air sweeps up from below, and acting first upon the excitable hydrogen of the oil or gas, ignites it, and acting also upon the carbon of the same, converts it into carbonic acid, which with its newly liberated particles forms the dark centre *b*. Almost in a twinkling these dark particles become radiant with heat as the inrushing oxygen makes more and more intense the action of the hydrogen and the contiguous carbon. This carbon which at first is converted into carbonic oxide (CO), on receiving a larger share of oxygen, assumes the more intense form of carbonic acid (CO_2), and becoming ignited and volatile with heat, spreads out into the luminous portion *c*. The very thin, almost invisible, bluish envelope *e*, *e*, is caused by the inward rush of the oxygen as it seeks its affinitive uprising hydrogen. This may be seen best by viewing a flame in its narrow direction. If the upper and more luminous part of the flame should be hidden by the hand or some other object, the exquisite blue, merging into indigo and violet, may be seen very distinctly. The same will appear in the flames made by burning wood, coal, paper, matches, and other objects, where the flame joins the lower part of these objects, as no elimination of luminelles can take place without the electrical flow.

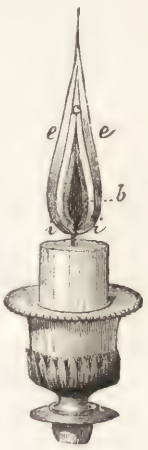


Fig. 162.

3. In the case of *magnesium light*, particles of magnesia (MgO) constitute the luminelles, in the *calcium light*, particles of lime (CaO), in burning *strontium*, particles of strontia (SrO), whose

luminelles are red, in burning *sodium*, particles of Soda (Na_2O) whose luminelles are yellow-orange, and so with other substances, as will be shown in the next chapter. As I have said before, however, carbon is by far the most common basis of luminelles for practical illuminating purposes.

4. Why do the luminelles of a flame when brought into contact with a person cause so much more pain than the usual atmospheric luminelles as ignited by the sunlight? Because they are coarser, far more condensed, and emit a ruder grade of heat. This will also explain why the luminelles of an ordinary flame or torch remain dark in the center for a moment, while those of the atmosphere are kindled without any appreciable length of time, as the larger ones require more time to become ignited than the smaller ones. Nature has kindly spread out through the atmosphere, those exquisite particles which may convey a suitable amount of light to us without burning either the eye or the skin.

XXIII. Smoke.

When a flame, as that of a lamp, is not supplied with a sufficient draft of oxygen to ignite all of its luminelles, and decompose them to a certain extent, they are carried up into the air in a dark condition which we call *smoke*. This smoke includes a certain amount of carbonic acid which is poisonous when inhaled, or carbonic oxide which is still more poisonous. Smoke consuming arrangements have been devised, but when they can be made so simple, cheap and effective as to be universally adopted, the great black cities where bituminous coal is used, such as London, Birmingham, Glasgow, and Pittsburg, will become comparatively clean and beautiful, will utilize much fuel and become more healthful.

XXIV. Non-Luminous Flames.

A jet of burning hydrogen, though very hot, is barely visible in the day-time. Alcohol emits but little light while burning. The intense heat of the oxyhydrogen blow-pipe causes a blue flame which is but feebly visible. These and some other very intensely hot flames, such as that of Bunsen's burner which combines air with gas, etc., give but a feeble light, and that gen-

erally of a bluish electrical character, thus showing a strong chemical action. We have already seen that these non-luminous flames come from a lack of luminelles or of some solid substance which may become incandescent. Solid matter becomes luminous in the day-time at a heat of 900° or 1000° F., but gases become only feebly visible at 2000°.

XXV. Coal-Gas.

The ordinary illuminating gas is made from bituminous coal, although gas of still higher illuminating power may also be made from oil, fat or resin. The most abundant ingredient of gas is *light carburetted hydrogen* (marsh gas), although a more highly illuminating part from its having twice as many carbon luminelles, is the *heavy carburetted hydrogen* (olefiant gas). The leading ingredients of *coal gas* are as follows, together with their specific gravity (weight as compared with air) :—

	Specific Gravity.
Light carburetted hydrogen (CH_4)	.552
Olefiant gas, or heavy carburetted hydrogen(C_2H_4)	.987
Sulphuretted hydrogen (H_2S)	.1192
Carbonic oxide (CO)	.96
Nitrogen	.9713

Besides these, there is a small amount of bisulphide of carbon, and some combustible hydrocarbons. It is highly important that it should be well purified of ammonia, sulphuretted hydrogen, and other deleterious ingredients.

XXVI. Kerosene or Coal Oil.

In its crude form this is called Petroleum or Rock Oil, and has become a vast source of home illumination. It is composed almost wholly of hydrogen and carbon. It is very important that it should have its benzine and other volatile elements so eliminated from it that it shall not be too light and combustible, as too many lives have been lost from the careless use of the cheaper and more impure oils. Kerosene oils ought to be able to endure from 130° to 150° of heat without combustion. An intelligent gentleman, skilled in its use, says that some of the worst explosions are caused by turning the light down low and letting it burn thus, by which means the metals around the burner become especially heated,

and through them the oil below is converted partially into gas which makes it doubly inflammable. With care, however, there should almost never be any danger from the use of this admirable and steady-burning kerosene flame whose illuminating power has been estimated at 7 times that of an ordinary candle, just as an average gas light is equal to 20 candles. The purest oil has almost the transparency of water, is almost odorless, is the least inflammable of all, and, when supplied with a shade, especially one which has some blue tint, is highly protective to the eyes and is well adapted for study, writing or sewing.

XXVII. The Oxyhydrogen Blow-Pipe

Consists of two gasometers, the one with oxygen, the other with hydrogen gas, which are brought in separate tubes and made to meet at the extremity where the two gases are joined in a single stream and lighted. The heat thus produced is the greatest known to man, with the exception of that which is developed through the agency of electricity, and in it metals will burn like wood or wax, iron sending off its brilliant luminelles, or scintillations ; copper, its green luminelles, and other metals their own special color of flame. Wood or coal burn easily by the addition of mere oxygen, because they have hydrogen as well as carbon ; but metals lacking the hydrogen in themselves will burn with a flame only when both hydrogen and oxygen are added, their own particles answering as luminelles. The electrical flame uses the hydrogen and oxygen in the vapor of the atmosphere in connection with the metals. The temperature of the oxyhydrogen flame, as shown by Deville and Bunsen, is from 4500° to 6000° F.

XXVIII. Calcium Light, or Lime Light.

When the feebly luminous flame of the oxyhydrogen blow-pipe is directed upon a cylinder of lime, which is oxygen and calcium combined, a most dazzling light is produced unequaled by any artificial flame excepting that developed by electricity. This is caused slightly by the luminelles of lime, but mainly by the intensely incandescent lime itself. Huggins discovered particles of lime in the spectrum of lime light. It is sometimes called the *Drummond light*, from the inventor. *Magnesium light* is made on the same principle, and is more permanent, as the magnesium

does not waste away as does the lime. Coal gas is sometimes used in the place of the blow-pipe, and is generally sufficient for illustrating spectrum analysis before a popular audience.

XXIX. Electric Light.

1. If a current of galvanic electricity be allowed to pass between points of charcoal which are attached to the two poles and held near each other, an intensity of light will be generated which will be almost unsafe to look upon, together with a heat that no scale at present known to man is capable of measuring. Faraday ascertained beyond dispute that electric sparks, flames, etc., consist of particles of the metal or charcoal which form the electrodes of the battery and the medium through which it passes, while the spectroscope clearly reveals as the component parts of the electric flame, the substance of the electrodes themselves, together with the hydrogen, oxygen, nitrogen and sodium of the atmosphere. We thus have luminelles from the electrodes and also from the atmosphere to aid in both the heat and light, while the currents of electricity, sweeping with inconceivable velocity, eliminate more or less of charcoal or other atoms, and driving them especially from the positive towards the negative pole, and somewhat from the negative to the positive pole, which poles are kept at a brief distance apart, kindle the atmosphere into a flame that will immediately melt away and vaporize solid metals, which may be placed in it. The electrodes are first placed near each other and then drawn apart a short distance, when the light will assume magnetic curves called the *Voltaic arc*, as in figs. 163, 164. Carbon, especially of the coke variety, is the best material for the points of the electrodes, 1st, because it is less apt to melt than metals, and, 2dly, its diverse lines of polarization do not allow the electricity to pass off too rapidly, but hold it until its tension is powerful, so that when it bursts over to the opposite pole from + to — it makes the more intense flame, and 3dly, a rough black substance is favorable for radiating light and heat.



Fig. 163. Fig. 164.

2. When the current usually called positive, which, as we have seen, is the chemico electricity (Chap. Third, XXXIV), flows downward as in the cut, the flame is more intense, and if

the two carbon points are arranged horizontally with the positive pole to the east or the north, thus throwing the current westward, or southward, it is also more intense. The explanation of this has not been given, so far as I have seen, and yet it is very simple when we learn about the dynamic forces of the earth, and the law of atoms. We have seen that chemico electricity developes more heat than other grades from its atomic law of movement, its spirilla being more external and consequently more curved than the other axial spirillæ. I shall show under the head of Chromo-Dynamics, that the thermal currents of the earth pass downward towards the center of the earth, also towards the west following the track of the sun, as well as from the poles toward the equator, while the cold electrical currents pass in just the opposite directions. If any one thinks that heat passes upward because a flame or a current of heated air passes thus, he should remember that this comes from convection, or that law of gravity which attracts heavy fluids towards the earth's center and crowds the heated and rarified fluids upward. The blue electrical portion of flames is at the lowest portion, not at the highest part, as would be the case if electricity passes downward. When this chemico-electricity, then, which is attended with more heat than the other kinds, moves downward or westward, or southward, it harmonizes with the thermal currents which are moving in the same direction, and thus becomes more intense than if going counter to them. The length of the luminous arch when the positive current moves westward, is said to be about one-fourth greater than when it moves eastward, or as 20.8 to 16.5. Despretz, with a powerful battery and with the positive current moving downward, obtained an arc of electrical light 7.8 inches long.

3. *Duboscq's Electric lamp* gives a most brilliant effect, and is sometimes used for taking photographs in place of the sun. Wm. Browning's electric lamp, of London, is considered still better and cheaper.

4. M. Lambotte has invented and applied to practical use on some of the railroads of France, his method of *lighting the stations* by electricity. Some light-houses are also illuminated by electricity.

5. *Magneto Electric-Machines* are found to be more convenient and effective for purposes of illumination than the mere

galvanic batteries. "Despretz has calculated that the light emitted by 92 of Bunsen's elements, arranged in two series of 46 each, is equal to that of 1144 candles, and is to the light of the sun as 1 to $2\frac{1}{2}$; and the light emitted by 250 elements in a grand experiment made by Profs. Cooke and Rogers, in the cupola of the State House, Boston, was calculated to be equal to that of 10,000 candles." Describing *Wild's magneto-electric* machine, Prof. Pynchon says:—"When an electric lamp furnished with rods of gas-carbon half an inch square, was placed at the top of a lofty building, an arc of flame several inches in length was projected and the light evolved from it was sufficient to cast the shadows of the street lamps, a quarter of a mile distant upon the neighboring walls. When viewed from that distance, the rays proceeding from the reflector have all the rich effulgence of the sunshine. With the reflector removed from the lamp the bare light is estimated to have an intensity of 4000 wax candles. A piece of ordinary sensitive paper, like that used for photographic printing, exposed to the action of the light for 20 seconds, at the distance of two feet from the reflector, was darkened to the same degree as a piece of the same sheet of paper when exposed for the period of one minute to the direct rays of the sun at noon on a clear day in March. In the month of June from a comparison of sunlight with the electric light armed with the reflector, by means of the shadows thrown by both, from the same object, the electric light seemed to possess three or four times the power of sunlight. That the electric intensity was somewhat in this proportion was evident from the powerful scorching action of the electric light upon the face, and the ease with which paper could be set on fire with a burning glass when introduced into its rays. The extraordinary calorific and illuminating powers of the ten-inch machine, are the more remarkable when we consider that they have their origin in six small permanent magnets weighing only one pound each, and capable of sustaining collectively only 60 pounds. It has been calculated that with a 100-ton magnet, having an armature of 32 inches in diameter and driven by a 1000 horse power steam-engine, light enough would be produced if the lamp were placed on the top of a high tower, to illuminate London by night more brightly than the sunlight does by day. Twelve machines of

the ordinary size would illuminate Broadway from the Battery to 14th Street, at much less expense than gas. * * * Wilde's machine has been greatly simplified and improved by throwing aside the permanent magnets and making use of the electro-magnet alone." (Chemical Forces.) Mr. Ladd, of London, has introduced this, and still further improvements.

5. *The Electric Candle.*

1. This must rank among the remarkable inventions of the day and will constitute a stepping stone to the still better invention of an electric light which, as I have no doubt, will yet be developed by a large permanent magnet, aided perhaps by machinery which shall be able to separate and bring the combustible elements of the atmosphere into range of its electricity. The following are accounts of the *Electric Candle* as cut from popular journals :—

2. "It has remained for a Russian—M. Paul Jablochkoff, who was formerly in the Russian military service—to demonstrate in practice the feasibility of subdividing the electric current. He has worked out his result in the form of an electric candle, which governs the production of the electric light and supersedes the ordinary clockwork arrangement. By it he has, moreover, demonstrated the possibility of obtaining several lights from a single source of electricity. The first practical trial of this system was made at the Magasin du Louvre, and the experiments were attended with perfect success. The Marengo Hall was the apartment lighted, and six electric candles were sufficient to shed around a very bright light, which was softened by being transmitted through opal glass globes. Some idea of the comparative value of gas and the electric light under notice may be formed when we state that the Marengo Hall is ordinarily illuminated by means of one hundred argand gas-burners of the largest size. The electric candle, as originally designed by M. Jablochkoff, consisted of what may be termed a double wick and a surrounding material. The wick consisted of two carbon points, about four inches long, embedded parallel to each other in an insulating substance, by which, also, they were separated from each other. This material, which was consumed as well as the double wick, was composed of several ingredients, forming

a combination known only to the inventor. Each of the carbon points terminated at the bottom in a small metal tube, into which the conducting wires were led. With these candles a series of experiments was some time since carried out by a War Office Committee of Royal Engineers at Chatham, England. It was then demonstrated as one result that the system gave fifty per cent. greater power of light than had ever before been obtained from any electric fluid. The next development of the electric candle by M. Jablochkoff was to denude it of its outer casting, leaving merely the double wick with a strip of the insulation compound between the carbon points, which terminated at the bottom in metallic tubes, as before. It was with the electric candle in this form that the hall at the Magasin du Louvre was illuminated, as previously stated. In either case only one electric machine is needed to produce a number of lights. The positive and negative wires are led from the machine, and branch wires are simply conducted from them at the necessary points to the candles. In this way M. Jablochkoff succeeded in getting as many as eight candles to burn at the circuit of a single machine of the ordinary kind, with alternating currents."

3. M. Jablochkoff's electric candle is spoken of in foreign journals as a successful endeavor to utilize the electric light. It was originally constructed on the principle of inclosing the carbon electrodes in a material which will consume slowly and thus regulate their burning, the carbon "points" serving as the wick to the candle. The outside material is believed to consist largely of kaolin. As many as 50 simultaneous lights are said to have been obtained by means of this invention from one electro-magnetic machine. Latterly M. Jablochkoff is reported as having dispensed with the carbon points altogether, using only the kaolin preparation for the electrodes. The invention has been described by M. Dumas before the French Academy of Sciences, and arrangements are in progress in England to light one of the East and West India Company's docks by the new system. If the electric candle meets the expectations that have been formed of it, the reign of the gas companies is nearing a conclusion."

4. "In the *Parisian Experiments* the kaolin bar ignited by induction spark was 8 centimetres long, and fully equal to 8 gas

burners. At the same time three electric candles were operated, each equaling about 40 gas burners." (Nature.)

5. At the *French Railway Station* where the electric candle is adopted, a large lantern clouded with zinc white is used to enclose the lamp and soften the intensity of its light.

6. In *Experiments of St. Petersburg*, "the most economical machine tried was that of Altenek, which with a galvanized carbon of 10 mm. diameter gave a maximum of 20,275 and a mean of 14,039 candles. The light was sufficient to make objects visible for military purposes at a distance of 3080 yards," or nearly two miles. (Nature.) If we consider 4000 candles equal to sunlight, the maximum light of Altenek's machine must be 5 times that of the sun. This would not signify that any possible light obtainable by man would absolutely compare with that of the sun, but that the electric light near by, can be made five times greater than sunlight which comes more than 92,000,000 miles. But the ideal *lighting and heating* methods, I think, must be made in connection with a permanent magnet, by means of which all fuel and all expense of batteries will be done away with, and our cold, dark world will be made into a far more magnificent habitation for man by means of methods which would involve no expense excepting the magnet with its attachments, and the simple trouble of starting it.

XXX. Heat of Various Combustibles.

Hydrogen, though producing but a feeble luminosity of flame, emits the greatest heat of any known combustible. The following table gives the amount of heat produced by various substances when they burn in air, the unit being the amount of heat necessary to raise a weight of water equal to that of the combustible, 1°:—

Hydrogen flame in air produces		34.462	units of	heat.
Light Carburetted Hydrogen	"	13.063	"	"
Illuminating Gas	"	11.858	"	"
Spermaceti	"	10.342	"	"
Turpentine	"	10.662	"	"
Alcohol	"	7.184	"	"
Wood Charcoal	"	8.080	"	"
Coke	"	8.047	"	"

Thus the hydrogen flame is three times as hot as that of illuminating gas, and more than four times as hot as that of charcoal or alcohol.

XXXI. Spontaneous Combustion.

Many substances having a powerful chemical affinity for each other, rush together with such violence as to kindle into flame. Potassium, when thrown upon water, causes a beautiful violet flame from its seizing the oxygen and tearing it away from the hydrogen, thus causing ignition of the hydrogen and the surrounding atoms. A stream of water may be set on fire by putting some pieces of potassium into a bottle of ether and pouring it over the stream. During the Crimean war, Mr. McIntosh proposed to destroy the shipping and harbor of Sebastopol by firing bomb shells filled with ether and containing pieces of potassium, but the British authorities feared its danger to themselves. Potassium, tin, pulverized copper, antimony, etc., take fire if put into chlorine gas. Phosphorus takes fire in the air and must be kept under water. Many substances burn in *nitrogen trioxide*, more familiarly known as *nitrous oxide* (N_2O_3). The terrific explosions that are sometimes caused by the rude handling of *nitro-glycerine* are well known, and for safety it is often kept under water. The phosphorus of matches, sometimes under too much of a jar or friction, sets houses on fire. Bromine is similar to Chlorine in causing combustion when united with certain metals. Gunpowder, and even buildings and ships are sometimes set on fire by calcium monoxide (lime, CaO) when water is thrown upon it. Sunlight falling upon a bottle of *hydrochloric acid* (*HCl*) immediately dashes the glass into powder from the affinitive action of its electrical rays with the thermal hydrogen within.

CHAPTER FIFTH.

CHROMO–CHEMISTRY.

I. Character of Spectrum Analysis.

1. When *solids* are heated until they become incandescent, they impart a brilliant light, some with one color as a predominant principle, and some with another: thus sodium gives a bright yellow-orange light, strontium and lithium, red; copper, green; arsenic, lilac; mercury, a pale blue, etc. These, however, are not the only colors which are emitted by these metals, but simply the most striking. As the potency of all substances may be manifested by their colors, would it not be admirable if some arrangement could be devised by which we could ascertain the exact reflective and refractive character of these colors, with their separate hues and tints? This can be done completely by letting a thin volume of their light, when thus heated or converted into a luminous vapor, pass through a triangular piece of glass or other transparent substance called a prism. (See Chapter on Chromo-Philosophy.) The lines of light striking diagonally on this glass (fig. 165) are jolted apart, the colors being thrown (retracted) farther and farther to one side in proportion as they are fine and elastic. Thus the blue is refracted much farther than the red, the violet than the blue, and the trans-violet still farther. When the *strontium* light comes to be sifted through the prism, we see that it has not only red light, but some orange, yellow and blue, and we can see just how fine a grade of red it is, and just the grade of the other colors, by its position in the spectrum. As compared with potassium, we would see that its red is finer than the same color in that substance, being farther toward the yellow; as compared with cæsium, its blue would be slightly coarser, being nearer the red end. But there is a more exact way of arriving at the position of these colors, for the spectrum of incandescent solids and



Fig. 165. The Spectrum.

liquids is in continuous masses of color, and not in lines which manifest the exact grade of potency and fineness. By getting a heat sufficient to convert these solids into luminous vapor or flame, we shall find their spectra appearing just as do the gases when made luminous, in bright lines of color on a comparatively dark ground, or sometimes in bands. For this purpose the electric light is best from its great intensity, although a Bunsen's burner or the blow-pipe may be used in some cases. A continuous spectrum is such as may result from an incandescent solid or liquid in which all the colors prevail, while in Plate I., the spectrum of the sun may be seen somewhat broken by dark Fraunhofer lines, the star Sirius with somewhat different lines, vaporized sodium with its one double line of intensely bright yellow orange, located at the point in the spectrum which is designated as D; the oxygen with its red, yellow, but especially blue and indigo, and so on with the other elements of hydrogen, nitrogen, and carbon. Why it is that some of the spectra have bright and others dark lines will be explained hereafter (See Chromo-Philosophy, III.).

2. The *spectrum of colors is divided off into fine degrees of measurement*, and also by Fraunhofer, into letters of the alphabet, each of which always signifies some exact position; thus A, Plate I., is a line in the dark red near the outermost verge of the visible spectrum, and constitutes one of the color effects of potassium and no other substance; B is a dim line in the finer grade of red, and belongs also to potassium; C in the still finer red, or rather very red orange, F in the blue-green, G in the indigo, and H in the dark violet, are the four especial and bright manifestations of *Hydrogen;* D is the intensely bright yellow, or really yellow-orange, which is always the sign of *sodium*, and so on. The visible spectrum does not appear with much distinctness excepting from the letters A to H, or H_2, although the rays of solar light are named to the end of the alphabet and extend very much farther still. Is it not evident now that whenever the flame of a substance burned gives the bright yellow line at D, sodium must be present? And whenever the very bright red line at C, or the line at F, or G, or H, or all of them appear, does it not show beyond all guess work, that hydrogen is present? And so with all the other elements which have

their exact lines in the spectrum caused by exact reflective characteristics of their atoms. The reader must see by this time that this method of chemical analysis must be incomparably more exact than any other. As a proof of its delicacy, take the fact that the 200,000,000th part of a grain of soda can be detected by its means, or the 6,000,000th part of a grain of lithium, or the 1,000,000th of a grain of strontium, or the 1,000,000th of a grain of lime! But incomparably smaller amounts still are really sufficient to distinguish each element. And yet a grain when measured out in water is only one drop! Does not the study of colors, then, open up a science to man, magnificent in its revelations of the minute, and minute in its revelations of the magnificent, taking the sun and stars to pieces on the one hand, and piercing far down towards the realm of atoms on the other? But not only does it reveal the potencies of matter, but ascends to the still grander empire of the soul, as we shall see hereafter in Chromo-Mentalism.

II. The Spectroscope.

1. In order to reduce these spectra of different substances to absolute system, with scales of measurement so that by comparison the lines of the different substances can be determined, an instrument called the *Spectroscope* (fig. 166), has been invented.

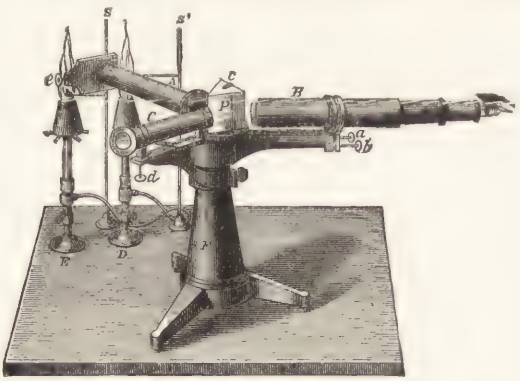


Fig. 166. The Spectroscope

The figure represents one of the best forms of the instrument as made by Steinheil of Munich. P, is a prism fixed upon the central iron stand. A, is a tube with a lens in the end near the prism, while the other extremity has a fine vertical slit for the

admission of light. The width of this slit is regulated by the screw *e*. The stand E supports a Bunsen's burner, or sometimes a common gas burner in the flame of which the substance to be analyzed is held by a sliding rod which moves up and down on the stand *s*. This burner is placed opposite the upper half of the slit and sends its light directly down the tube to the prism P. On the other side of the slit is placed a small prism, the object of which is to reflect some other light, such as the artificial flame on the stand D, or the light of the sun through the lower half of the slit, which is also carried to the prism P. This brings the two spectra into the field at once, one being placed above the other so that any desired comparison can be made. Suppose, for instance, we wish to know if there is any sodium or lithium in a certain substance; by testing it side by side in one burner with that which is known to be sodium or lithium in the other, we can at once see whether the lines correspond, or differ. The light having been refracted by the prism P, is received and magnified by the telescope B, as it passes on to the eye. The telescope is capable of horizontal movement so as to take in every part of the spectrum formed by the prism. Another arrangement for facilitating the comparison of spectra is the tube C which contains a magnifying lens at the end nearest the prism, while at the other end it has a millimetre scale formed by transparent lines on an opaque ground, a reflection of which is thrown into the telescope from the surface of the prism. For this purpose, of course, a light must be placed at the outer end of the tube C. This illuminated scale is thus seen between the two superimposed spectra and the position of all lines can thus be accurately determined.

2. A greater number of prisms are sometimes used to disperse the light more widely, but a more intense light will thus be needed to penetrate them with equal clearness. When in use, the instrument is covered with a black cloth to exclude the stray light

III. Metals Discovered by the Spectroscope.

The German chemist Bunsen discovered by means of the spectroscope, the new metal called *cæsium*, meaning *bluish gray*, and another metal *rubidium*, from *rubidus, dark red*. He evap-

orated 40 tons of the mineral waters of Durckheim and Baden and thus obtained 105 grains of chloride of Cæsium. Afterwards the eminent English chemist, Prof. Crookes, discovered *thallium*, while the two German chemists Reich and Richter discovered *indium*. Thallium from *Θαλλος* means a *budding twig*, from allusion to the brilliant green line of its spectrum. The metal Davyum, called so from Sir Humphrey Davy, has lately been discovered by Serge Kern in the same way. It is a platinoid metal

IV. The Spectrum.

As already described, when the light of the sun or of white flame is passed through a prism, it is divided off into an oblong series of lines constituting its spectrum. This extends from the red to the violet and sends invisible rays of force far beyond each of these points, the coarser trans-red rays being at the

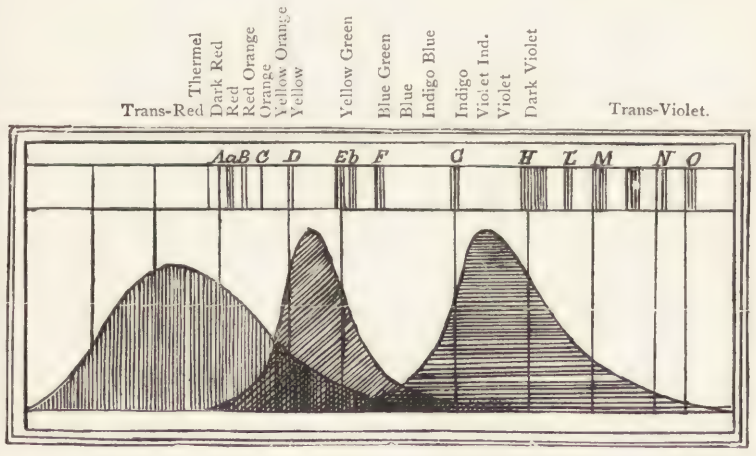


Fig. 167. The Solar Spectrum.

heat end of the spectrum and the trans-violet rays being at the cold end. Fig. 167 is copied mainly from the work on Spectrum Analysis by Prof. Henry E. Roscoe, F.R.S., with some of my own explanations attached. It will be seen that he has placed the culmination of heat considerably beyond the red, in fact just about where we might expect the thermo-ethers to come just below thermel on the atom. Prof. Robert Hunt represents it much

the same and has discovered several regions of heat in the trans-red which seem like islands, distinct and by themselves. This has been considered mysterious, but according to the preceding law of atomic spirals which places them in clusters, it loses its principle aspect of mystery.

4. The *Luminosity of the spectrum* culminating in the yellow, diminishes rapidly on each side of it. Fraunhofer found by careful measurement, that if the greatest intensity of light as it exists in the yellow were expressed by 1000, orange would be 640; medium red, 94; the outer red, 32; green, 480; blue, 170; indigo, 31; violet, 6. According to Vierordt, the comparative luminosity of colors may be represented as follows: Dark red, 800; red, 4930; orange-red (very red-orange,) 27730; orange, 69850; yellow, 78910; green, 30330; cyanogen blue, 11000; blue, 4930; ultra marine blue, 906; violet, 359; dark violet, from 131 to 9. This estimate makes the medium red and blue equally luminous. On any estimate the thermal colors are much more luminous than the electrical, taken as a whole.

5. The *Electricity of the spectrum*, formerly improperly called their actinism or chemical force, has been traced out by Mr. Stokes, by careful experiments with the very sensitive substances, hydrogen and chlorine placed in water, and the culminating point which is given in fig. 167 is in the violet-indigo, or about where the indigo merges into the violet. Other substances, however, will evoke the greatest electricity to the right or left of this. Mr. Stokes made observations on the solar spectrum from A to W, and found that what he called chemical force in connection with his hydrochloric acid, dwindled down to almost nothing between E*b* and F, where the blue-green commences on the one side, and at S, far in the trans-violet, on the other side. Does this signify that the real potency of the solar rays diminishes as they become finer in the trans-violet, contrary to the principle stated in Chapter First, XV.? No; it simply signifies that the invisible rays soon become too fine to act directly on coarser elements, or to be measured by ordinary instruments. Another point proper to be considered here, is, that this prominence, representing actinism as some have termed it, but which is more properly the realm of electricity, extends somewhat, though with highly diminished power, into the invisible rays which must con-

stitute the thermal portion of the next octave of colors. Can the second grade of red, situated in the trans-violet, act with a power somewhat similar to electricity? Doubtless it can, as seems very clear from the nature of atoms. Electricity has a penetrating power, because of its narrow, pointed and swift streams of force. May not a fine thermal spiral become nearly as penetrating as the coarser grade of axial spirals which are the principle of electricity? It must be so. For proofs that the various hues of blue-green, blue, indigo and violet, are grades of electricity, see Chapter Third, XXIX. In the strictest sense of the word, of course, the immediate trans-violet rays are not electrical, but rather a higher grade of thermism, a grade so fine as to convey but a feeble, if any, impression of heat to the outward senses. That these higher grades of heat and cold can be felt by certain persons, when in a specially sensitive condition, will be shown in the chapter on Chromo-Dynamics. As a proof of the increasing amount of heat as we go from the electrical to the lower thermal colors, I will quote the following statistics given by Sir H. Englefield, as ascertained from experiment:—

The thermometer rose in the different rays as follows:

In the blue rays in 3 minutes from 55° to 56°, or 1°
In the green rays in 3 " " 54° to 58°, or 4°
In the yellow rays in 3 " " 56° to 62°, or 6°
In the full red in 2½ " " 56° to 72°, or 16°
In the edge of red in 2½ " " 58° to 73½°, or 15½°
Below the red in 2½ " " 61° to 79°, or 18°.

This shows that there was 18 times as much heat effect produced from the trans-red ray in 2½ minutes as from the blue ray in 3 minutes. The violet ray, of course, has still less heat than the blue.

V. Laws of Color and Phenomena of Spectrum Analysis.

1. Notwithstanding the marvelous achievements in spectroscopy by our scientists, the real potency of colors and some of the most important lessons of spectrum analysis do not as yet seem to be apprehended. Aided by the law of atoms, we shall see if we cannot understand some of the mysteries of this subject before we get through with this, and the next chapter. Prof. Balfour Stewart has deduced some very correct rules about the

radiation and absorption of light and heat. One of his principle rules, however, is the following, which is generally true of chromatic but untrue of achromatic colors : "*Bodies when cold absorb the same kind of rays that they reflect when heated:* Heat a piece of green or blue glass, which absorbs red rays, and its light when viewed in the dark will be found to be particularly red, being the kind of light which it absorbs when cold." This law is correct as applied to most chromatic substances, but how will it apply to white, black, or gray substances? The substance sodium reflects yellow when heated, but absorbs no color at all when cold, being white; in the same way potassium, lithium, barium, magnesium, zinc, tin, bismuth, silver, antimony, nickel, platinum and various other elements reflect, when heated, every variety of color, and when cold absorb none, being white. Again, the black substance carbon absorbs all the colors when cold, but does not reflect them all when heated. The learned Professor seems to see a discrepancy in his argument and aims to mend it as follows:—" Make a spectrum of the electric light after the manner already described and hold burning sodium between the electric lamp and the slit; it will be found to produce a comparatively dark band in the spectrum. Next, stop the electric discharge while the sodium is left still burning; the same band will now appear luminous, that is to say, the sodium, which being comparatively cold when compared to the temperature of the electric light, stops one of the rays, gives out, when heated, this very ray on its own account. All these experiments tend to show, as a matter of fact, that bodies when cold or comparatively so, absorb the same rays which they give out when heated." In the above Prof. Stewart has fallen into the error of all scientists of the day so far as I know, that the intermediate sodium flame (or any other flame) "*absorbs* the same color which it emits." For *absorbs* the word *reflects* should be used, as a yellow flame or anything else which is yellow, can only be so by *repelling* instead of *absorbing* the yellow principle and the hotter it is, the more powerful is the repulsion. But I shall aim to make this principle clear under the head of Chromo Philosophy. We must reach the basic principles of force before correct laws can be evolved.

2. Prof. Roscoe says : "Can we find out any relation between the spectra of the members of some well-known family, as of the

alkaline metals, potassium, sodium, cæsium and rubidium? Some questions as these naturally occur to every one. At present, however, this subject is in such an undeveloped state that the speculations are useless, because they are premature and the data are insufficient; but, doubtless, a time will come when these matters will be fully explained, and a future Newton will place on record a mathematical theory of the bright lines of the spectrum as a striking monument of the achievements of exact science." I think Prof. Roscoe is wrong in saying that "speculations on these subjects are useless," for it can be conclusively shown that *the alkaline and other electro-positive metals belong to the thermal colors of the spectrum, that the more electrical substances, usually known as electro-negatives have great power in the electrical colors of the spectrum, etc.*, and that many other laws can be arrived at.

3. Spectrum analysis and the knowledge of color-potencies if crystallized into a science, would become among the most wonderful studies of the day. During these thousands of years all substances have been proclaiming their leading qualities to man by means of their colors, and it is now quite time that he should open his eyes and see what they are. Spectroscopy, for all its remarkable revelations, is still young, and many of its facts have been thrown up pell-mell, like piles of stones, beautiful stones it may be, but yet unsystematized. I shall now make the attempt to arrange these stones into an edifice, and fondly wait for some future scientist to make this edifice far more complete.

VI. The Spectrum of an Element.

1. *Exhibits the colors which that element repels or reflects when under chemical combination, or other intense action*, for a spectrum can be taken only when a substance is made luminous with heat, as in combustion, which is a process of chemical action, or by incandescence. Thus sodium being yellow in the spectrum, must ever, when combined chemically, repel the yellow principle of its own grade.

2. *The ordinary color of an element when cold or isolated, or mixed unchemically with another element shows the feeble grade of repulsion which occurs in that state* · thus sodium be-

ing white in its cold or uncombined condition, repels all colors, though far more feebly than it repels the yellow when made luminous with heat, and if pulverized and mixed with the yellow of sulphur, the particles of each substance would be unchanged in color.

3. *The Potency of a Substance, as determined by its colors, is quite different in its cold unchemical state from that which is exhibited in its spectrum, or when chemically combined:* thus, the repulsion of gold, in its ordinary cool state, is in the yellow principle, while in its heated state its strongest repulsions are for the yellow, yellow-green and orange, and potassium in its ordinary state, being white, repels all colors, while under great heat, its leading repulsion is for the red.

VII. Chemical Repulsions and Affinities.

While the Chemical repulsions of a substance may be determined by the colors of its spectrum, Chemical Affinities may be determined by the same colors in harmony with the law already given (Chap. Third, XXXVII, 10). Thus the spectrum of sodium being the D grade of yellow-orange, it must affinitize most strongly with some substance which has a prominent spectrum in the violet-indigo, although it must have a sufficient affinity for all the other colors which do not appear in its spectrum to absorb them and hide them from view. Again, the spectrum of silver shows that its greatest repulsions are for the yellow, yellow-green, and blue-green, consequently its greatest affinities must be for the violet, dark violet, and thermal, which facts, in connection with others that will be given hereafter, will explain why photographic paper, saturated with silver nitrate, is so sure to draw violet-grays and dark elements to itself when exposed to the sunlight. One more example may be given as a striking confirmation of this law of chemical affinity. Hydrogen gas, though exhibiting several colors in the spectrum, has a flaming red or very red-orange as its ruling color, which swallows up all the others as seen in its flame. It is admitted by scientists that the blue of the sky comes from the vapor of the atmosphere, of which, two atoms of hydrogen to every one of oxygen, are the constituents. But according to the principles of chemical affinity already explained, hydrogen must form the encasing atom and consequent-

ly must give color to the vapor, while the colors of the oxygen are invisible, its color being encased in the hydrogen. Why then is not the sky red, in harmony with the spectrum of hydrogen? Because the red elements of the sunlight, striking the hydrogen of the vapor, must necessarily be repelled by it, before they reach us (VI) while only the affinitive color of the red, namely the blue, can be transmitted to our eyes. (See XX of this chapter).

VIII. White or Light-Gray Elements.

Substances which in their ordinary cold or uncombined state have a predominance of white or light gray, partake most of the electrical condition, while those which under the same circumstances are black or dark gray have the thermal condition in excess. The reason of this is that the thermal colors which constitute a great share of the luminous or white principle will not allow the warm rays to enter, and thus white or light-colored substances, though possessing the greatest heat repulsions are, within themselves, really in a cold or electrical condition. By the same reasoning it is easy to show that while in black or dark gray substances, the electrical colors and perhaps also the trans-violet and trans-red are nominally the most active, yet their ordinary condition is more charged with heat than with cold. This principle, which is of great importance, and will more clearly appear in the paragraphs following, is founded on the law already shown that *when thermal colors are repellent so as to become visible, their corresponding electrical colors are generally absorptive and consequently invisible, and vice versa.* Thus when orange is visible in the spectrum the corresponding indigo will usually be invisible, and when violet is visible, the corresponding yellow will be invisible, etc. Experiments show that when a very small portion of some electrical color, especially blue, or blue-green, is combined with the thermal colors, white is the result, while the thermal colors alone including the yellow-green, will make a good approximate white. Again when the electrical and dark elements appear, the more luminous elements are apt to be absorbed and to become invisible. For this reason blue glass will absorb more heat and grow warmer to the touch than yellow glass, although blue is a cold color, a black substance will absorb still more, and a white one is the coldest of

all. Snow, scraped ice, frozen carbonic acid, etc., are good examples of the whiteness which often accompanies an electrical condition, although in many substances their whiteness does not manifest the grade of electricity which gives an especial sensation of coldness. Carbon, in its ordinary condition, is a good representative of black substances, being the leading element from which artificial light and heat are evolved.

IX. The Spectra of White Colors.

1. *Elements which are white or approximately white, have a preponderance of thermal colors in their spectra and their potencies are those of heat rather than cold in all chemical combinations.* This will be at once evident on looking at the spectra of alkaline metals which, in their ordinary condition, are white and silvery. These metals are potassium (bluish white,) sodium, lithium, barium, strontium, (light gray), calcium (yellowish white), magnesium, rubidium and cæsium. The same is also true of the other white metals such as platinum, palladium, &c. To show that these principles are founded on facts and also to afford an inside view of the potencies of the various elements as revealed by the spectroscope, I have elaborated and condensed the following tables from the experiments of such spectroscopists as Kirchhoff, Bunsen, Huggins, Ångström, Thalen, Plücker, Mascart, Lockyer, and especially from "Watt's Index of Spectra," a work which combines the results of all the principal experimentalists and which would be quite valuable had it been explained with a little more lucidity. Some authors seem to be afraid to make their points clear, for fear they will be considered unlearned.

2. It may be well here to remark that spectroscopists have doubtless made some mistakes in using extreme heat for the alkaline and other metals in which thermism rules, as it should be remembered that thermal colors require less heat to develope their activities than those which are electrical. It should be remembered too that it is no proper index of the chemical potency of gases, for instance, to put them under great pressure and then send the most intense electrical spark through them, for it is evident from the law of atoms that if we cause the color-spirillæ to vibrate violently with extraordinary heat, all colors will be reflected (repelled) by them and hence we shall have a continuous spectrum

as is the case with incandescent liquids and solids. Below I have enclosed some of the colors in parentheses which do not appear in case of a moderate heat.

3. I have represented colors of feeble intensity by the common Roman type, those of moderate intensity by *Italics*, those of considerable intensity by SMALL CAPS, those of great intensity by LARGE CAPS, and those of the greatest number of intense lines by exclamation points (!). I will give their symbols, one of their more common or important compounds, and their weight (specific gravity), as compared with water, with the letters *sp. gr.*

X. Spectra of the Alkaline Metals.

Color when cold and uncombined, white. Thermal colors predominate in their spectra.

Thermal Colors.	Electrical Colors.
Potassium (K, Kalium), (Potassa, K_2O).*	Sp. gr. 0.865.
RED! (YELLOW).	(*Blue Green,*) *Violet.*
Sodium, (Natrium, Na.,) (Soda, Na_2O).	Sp. gr. 0.972.
(Orange.) YELLOW-ORANGE! (*Yellow-Green*).	(Blue-Green).
Lithium (Li.), (Lithium hydrate Li HO).	Sp. gr. 0.594.
RED! *Yellow-Orange*, Yellow-Green.	(BLUE).
Barium (Ba.), (Baryta, BaO).	Sp. gr. 1.5.
Red, RED-ORANGE, YELLOW, YELLOW-GREEN!	(BLUE, VIOLET).
Strontium (Sr.), (Strontia, SrO).	Sp. gr. 2. 54.
RED, RED-ORANGE! YELLOW, YELLOW-GREEN.	BLUE (INDIGO, VIOLET).
Calcium (Ca.), (Lime, or Calcium monoxide, CaO).	Sp. gr. 1.578.
RED-ORANGE! ORANGE, YELLOW, YELLOW-GREEN.	(IND.-BLUE), VIOLET-INDIGO, (DARK-VIOLET).
Magnesium (Mg. Magnesia, MgO).	Sp. gr. 1.75.
YELLOW-GREEN!	*Blue.*
Rubidium, (Rb).	Resembles Potassium.
RED-ORANGE! YELLOW-GREEN.	Violet-Indigo.
Cæsium. (Cs).	Resembles Potassium.
Red, ORANGE! YELLOW-GREEN.	Blue.

* Potassium was formerly called the most *electro-positive* of elements by electricians, which is but another name for thermal. It has since been found that Cæsium is the *most* electro-positive, then rubidium, then *potassium*, then sodium, etc.

XI. Spectra of other White or Light-Colored Metals.

General Predominance of Thermal Colors.

Thermal Colors.	Electrical Colors.
Aluminum, (Al.) (Alumina, Al_2O_3).	Sp. gr. 2.56 to 2.67.
ORANGE, YELLOW ! YELLOW-GREEN.	BLUE. Dark Violet.
Cadmium, (Cd.) (Cadmium Oxide, CdO).	Sp. gr. 8.7.
Red, RED-ORANGE, YELLOW ! YELLOW-GREEN.	BLUE.
Silver, (Ag.) (Silver-Nitrate, $AgNO_3$).	Sp. gr. 10.5.
YELLOW ! YELLOW-GREEN.	(Blue-Green).
Palladium, (Pd.) (Palladium monoxide, PdO).	Sp. gr. 11.8.
YELLOW ! YELLOW-GREEN.	*Blue*, Indigo.
Thallium, (Tl) (Thallium Monoxide, Tl_2O)	Resembles Lead in its properties.
Yellow, YELLOW-GREEN !	*Blue.*
Platinum. (Pt.) (Platinic chloride, Pt Cl_4).	Sp. gr. 21.15 to 21.5.
YELLOW ! yellow-green.	Indigo-Blue.
Uranium (U) Uranic Oxide, U_2O_3.	Sp. gr. 18.4.
Yellow-Orange, YELLOW ! *Yellow Green.*	INDIGO-BLUE, INDIGO.
Bismuth (Bi) (Bismuth Pentoxide, Bi_2O_5).	Sp. gr. 9.9.
Red, Orange, YELLOW, YELLOW-GREEN !	Blue-Green, BLUE, Indigo.
Zinc. (Zn.) (Zinc Sulphate, Zn SO_4).	Sp. gr. 6. 86 to 7.1.
RED ORANGE, YEL.-ORANGE ! YELLOW.	BLUE-GREEN ! BLUE.
Nickel (Ni.) (Nickel Monoxide, NiO).	Sp. gr. 8.8.
Orange, YELLOW-ORANGE, *Yellow*, YELLOW-GREEN !	BLUE GREEN, BLUE.
Antimony, (Stibium, Sb) (Antimony trioxide, Sb_2O_3).	Sp. gr. 6.8.
Red, YELLOW-ORANGE ! YELLOW, Yellow-Green.	BLUE, INDIGO.
	[Hg_2Cl_2).
Mercury (Hg, Hydrargyrum) Sp. gr. 13.6.	(Mercurous chloride, (Calomel)
ORANGE, YELLOW !	INDIGO, *Violet.*
Tungsten. (Wolfram, W.) (Tungsten trioxide, WO_3).	Sp. gr. 17.6.
YELLOW ! YELLOW GREEN.	BLUE-GREEN, *Indigo.*
Arsenic (As.) (Arsenic Acid, As_2O_5).	Sp. gr. 5.88.
ORANGE, YELLOW ! *Yellow Green.*	Indigo—Blue.
Tellurium (Te) (Telluric Acid, TeO_4 H_2).	Sp. gr. 6.11.
RED-ORANGE, YELLOW-ORANGE, YELLOW ! YELLOW-GREEN.	Blue, Violet.
Molybdenum (Mo) (Molybdenum monoxide, Mo O).	Sp. gr. 8.63.
YELLOW-ORANGE, YELLOW !	Blue, *Indigo.*
Tin, (Stannum, Sn.) (Tin Monoxide, SnO).	Sp. gr. 7.29.
Red. RED-ORANGE, YELLOW ! *Yellow-Green.*	*Blue-Green*, BLUE.

SPECTRA OF WHITE ELEMENTS CONTINUED.

THERMAL COLORS.	ELECTRICAL COLORS.
Vanadium, (V.) (Vanadium dioxide V_2O_2).	
ORANGE! YELLOW-ORANGE, YELLOW, *Yellow-Green.*	*Blue-Green, Blue,* INDIGO, *Violet.*
Iridium and **Ruthenium** (Ir. and Ru.). *Orange,* Yellow.	Sp. gr. of Ir. 21.15, of Ru. 11.4
Rhodium (Rh.) (Rhodium monoxide, RhO). Spectra too faint to measure. Rhodic salts are	Specific Gravity 10.6 to 11. generally rose colored. (Fownes.)
Davyum, A platinoid metal, Sp. gr. 9.385.	Discovered, June 1877, by Kern.
Red, Orange, Yellow, Yellow-Green.	Blue, Indigo, Violet.

XII. SPECTRA OF BLACK OR DARK ELEMENTS.

These, though normally in a thermal condition as has been shown, *present, when combined in their spectra, either a predominance of thermal colors, from their belonging to the trans-violet grade of black in the spectrum, or of electrical colors, from belonging to the trans-red black, or a supply of both thermal and electrical colors from comprising both grades of black. Their most common potency is that of heat.*

THERMAL COLORS.	ELECTRICAL COLORS.
Carbon (C.) (Carbonic Acid or Carbon dioxide CO_2).	Sp. gr. of charcoal, 1.7; Diamond, 3.5.
YELLOW-ORANGE! (Yellow and Yellow-Green bands strongest).	(Blue-Green, Indigo, and Violet-Indigo bands feeble.)
Iodine (I. Blue-black.) (Iodic acid, I_2O_7,H_2O).	Sp. gr. 4.946
ORANGE, YELLOW-ORANGE, YELLOW!! YELLOW-GREEN.	Blue-Green, Blue.
Silicon, (Si) (Silica or Silex SiO_2) Sometimes dark brown, sometimes colorless. The following is the Spectrum of **Silicon Chloride** ($SiCl_4$).	Sp. gr. of Silica, 2.66. Colorless rock-crystals, quartz, flint, agate, chalcedony, are nearly pure silica.
RED-ORANGE; Yellow-Orange and Yellow-Green-Bands.	(Violet-Indigo bands).
Osmium, Os.) (Black Powder. Berzelius).	Heaviest of Metals, Sp. gr. 21.3 to 22.477.
Orange, Yellow.	INDIGO-BLUE! *Violet-Indigo.*
Tantalum Ta.) A black Powder. }	Spectra of these two metals too
Niobium or **Columbium** (N.) Do. }	feeble to be measured.
Glucinum (grayish black Powder).	
Only 2 lines of the spectrum ascertained.	*Blue, Indigo-Blue.*

2. In the above spectrum of Carbon, the thermal colors are quite predominant; another spectrum of the same makes, the

electrical colors abundant. Iodine presents a blue electrical black, and so gives a powerful thermal spectrum according to the principles of chemical affinity, and yet the fact that it boils at 347°F. with a beautiful violet vapor shows that it is capable of exciting electrical action. Its power to *burn* is well known. Silicon-chloride doubtless presents a partly correct idea of the spectrum of silicon itself, which is the encasing atom, although a portion of the yellow and yellow-green must come from the chlorine, from its plurality of atoms.

3. It is quite evident that black substances are very apt to develope some style of heat, from their thermism, as for instance *carbon*, which developes the heat of flame and incandescence, iodine, black cantharis, etc., which develope the kind of heat that *burns* into the flesh, and black pepper, black mustard, black helebore, cloves, etc., which cause a *burning* sensation to the taste. Of course the red principle is a still more direct and positive manifestation of heat, as in the redness of burning coals, the redness of cayenne pepper (capsicum), etc. The grades of heat which appeal to the taste, etc., are too fine to be measured by the thermometer. It will be seen hereafter that transparent substances being strong in both thermal and electrical forces, may develope heat and cold and all other styles of power.

XIII. Spectra of Elements with Gray and Neutral Colors.

Elements possessing a more medium and less positive class of tints, such as iron with its iron-gray, lead with its bluish-gray, etc., generally have both the thermal and electrical colors developed in the spectrum. The lead-like element Indium is a rare metal, and its spectrum as given below may be considered as imperfect, judging by all analogies. In arranging my different groups, I may at times commit some slight errors, as it has been impracticable to have all the elements by me for comparison, and I have necessarily had to depend upon our chemistries in part for the description of their colors, which I find is not always entirely accurate.

Thermal Colors.	Electrical Colors.
Iron, (Ferrum, Fe.) (Ferrous oxide, FeO). RED–ORANGE, ORANGE, YELLOW!!! YELLOW–GREEN!	Sp. Gr. 7.79. BLUE–GREEN, INDIGO–BLUE, INDIGO, VIOLET–INDIGO!! VIOLET.
Lead, (Plumbum, Pb.) Sp. gr. 11.45. RED, *Yellow-Orange*, YELLOW! YELLOW–GREEN!	(Lead Monoxide, or Litharge PbO). INDIGO, VIOLET–INDIGO, *Violet.*
Erbium and **Yttrium** (Eb. & Y.). ORANGE, YELLOW-ORANGE, YELLOW! YELLOW–GREEN.	In dark-gray powders. BLUE–GREEN, Blue, INDIGO, Violet.
Indium, (In.) Lead Gray Color, (Only 3 lines of the spectrum ascertained.)	Marks paper like lead. BLUE, VIOLET.
Zirconium, (Zr.) (Steel gray, etc.). ORANGE! *Yellow, Yellow-Green.*	(Zirconia, ZrO_2 Sp. gr. 4.35 to 4.9). BLUE! Indigo, Violet.
Cerium, (Ce.) (Cerous Oxide, CeO). YELLOW, YELLOW–GREEN.	(Cerium sulphate, $CeSO_4$). BLUE, INDIGO–BLUE! INDIGO.
Lanthanum, (La.) Has colorless salts. Yellow, YELLOW–GREEN.	(Lanthanum Monoxide, LaO). BLUE–GREEN, BLUE! VIOLET-INDIGO.
Didymium, (Di.) Has rose-colored salts. Yellow, *Yellow-Green.*	(Didymium hydrate, DiH_2O_2). BLUE–GREEN, BLUE, VIOLET-INDIGO.
Chromium, (Cr.) Dark-Gray. Sp. gr. 6.81. Yellow, YELLOW–GREEN!	(Lead chromate, or Chrome Yellow, CrO_4Pb). Blue, INDIGO!
Manganese, (Mn.) (Manganese dioxide MnO_2). YELLOW–ORANGE, *Yellow.*	Sp. gr. 7.13 to 8. BLUE–GREEN, BLUE! Indigo-Blue, VIOLET–INDIGO, Violet.
Cobalt, (Co.) Red-gray. Sp. gr. 8.54. *Orange*, Yellow Orange, Yellow, *Yellow-Green.*	(Cobalt monoxide, CoO). BLUE–GREEN! BLUE, Violet-Indigo.
Thorium, or **Thorinum** (Th.) Sp. gr. 7.9. *Yellow.*	(Thorium oxide, or Thorina, ThO) *Blue-Green*, INDIGO!

XIV. Spectra of Elements with Positive Colors.

Certain elements in their normal condition exhibit positive or chromatic colors. These colors belong to the thermal group, there being no positive electrical colors among the elements. These elements include *gold* (yellow), *copper* (red orange), *Selenium* (reddish brown), *Sulphur* (pale yellow), *chlorine* (greenish-yellow, or very yellow-green), *titanium* (reddish), and *bromine* (a red liquid).

When submitted to chemical or heat action as exhibited in the spectrum, they change their potencies according to the following laws :

1. Their principal change is towards the finer end of the spectrum, including a grade of thermal colors finer than their own and more or less of the electrical colors, on the law of calorescence already explained. (Chapter Third, XXXIII.)

2. The most rapid change towards the finer electrical colors, and the greatest chemical power occurs in the case of the elements which approach to lightness and tenuity, according to the law explained in Chapter First, XV, as may be seen by examining the spectra of sulphur, chlorine and bromine, as well as by investigating their chemical potencies elsewhere.

3. The slowest change towards the electrical forces occurs in the heaviest metals of the group, gold being the heaviest and most feebly electrical, and copper next.

The spectra of these elements are as follows :—

Thermal Colors.	Electrical Colors.
Gold (Aurum, Au.) (Auric chloride, $AuCl_3$).	Sp. gr. 19.3 to 19.5.
Orange, *Yellow-Orange*, YELLOW! YELLOW-GREEN.	*Blue*, Indigo-Blue.
Copper (Cuprum, Cu.) Sp. gr. 8.96	(Copper Monoxide, CuO black).
Red-Orange, YELLOW, YELLOW-GREEN!	*Blue-Green, Blue, Indigo.*
Selenium, (Se.) Sp. gr. 4.3	(Selenic Acid, SeO_4H_2).
Red-Orange, Orange, YELLOW, YELLOW-GREEN! (with orange and yellow-bands.)	BLUE-GREEN! BLUE! (with Indigo-Blue, Indigo, and Violet-Indigo bands).
Sulphur, (S) (Sulphuric acid SO_4H_2).	Sp. gr. of roll sulphur, 1.98.
Red-Orange, ORANGE, YELLOW!! YELLOW-GREEN!	BLUE-GREEN, BLUE!! INDIGO-BLUE! INDIGO, VIOLET-INDIGO, (various bands).
Bromine (Br.) (Bromic acid, BrO_3H).	Sp. gr. 2.976.
Red, ORANGE, YELLOW! YELLOW-GREEN.	BLUE-GREEN, BLUE! Violet-Indigo.
Chlorine. (Cl.) Sp. gr. 2.47	(Hydrochloric acid, HCl).
Orange, YELLOW! YELLOW-GREEN.	BLUE-GREEN! BLUE, INDIGO, Violet-Indigo.
Titanium, (Ti.) (Titanic Chloride, $TiCl_4$).	Sp. gr. of Titanic Chloride, 1.76.
ORANGE, YELLOW-ORANGE! YELLOW!! YELLOW-GREEN!!!	BLUE-GREEN, BLUE!! INDIGO-BLUE!! INDIGO, VIOLET-INDIGO.

XV. Spectra of Transparent Substances.

As Transparent Substances affinitize with and transmit the different grades of color, both thermal and electrical, they present nearly equal amounts of both thermal and electrical colors in their spectra, the electrical power on the whole preponderating.* This may be explained as follows:—While in their ordinary cool condition their spirillæ attract into themselves all the color ethers, and pass them through, with some equality of power. When these same spirillæ become agitated by heat or by chemical action, their motions are sufficiently violent and repulsive to reflect a considerable part of the same color ethers which they before received, and this intensity and quantity of reflected colors is great in proportion as the action is great. The following table gives the spectra of the three powerful gaseous elements of Oxygen, Hydrogen and Nitrogen, which are absolutely transparent so as to be invisible, as well as the solid element of Phosphorus which, in its pure state, is colorless and translucent:—

Thermal Colors.	Electrical Colors.
Oxygen (O) (Water, OH_2) the most abundant of earthly elements, just as hydrogen must predominate in space.	Sp. gr. (compared with air) 1.1057. Combines with all elements excepting Fluorine and is the most electrical of all.
Red, Red-Orange, Orange, YELLOW, YEL.-GREEN.	BLUE, INDIGO-BLUE! INDIGO, VIOLET-INDIGO, *Violet.*
Hydrogen, (H) 14⅓ times as light as air.	The most volatile and thermal element.
RED, or very RED-ORANGE!	BLUE-GREEN, INDIGO, DARK VIOLET.
Nitrogen. (N) (Nitric Acid, N_2O_5).	Sp. gr. compared with Air, .9713.
Red, Red-Orange, YELLOW-ORANGE, YELLOW! YELLOW-GREEN.	BLUE-GREEN, BLUE! (Blue bands) INDIGO-BLUE! (Violet-Indigo and Violet bands).
Phosphorus (P) (Phosphoric acid, PO_4H_3).	Sp. gr. 1.77 to 2.14.
Red-Orange, YEL.-ORANGE, YELLOW! YELLOW-GREEN.	BLUE! (Bands in Blue, Indigo-Blue and Violet-Indigo).

* The reader may ask how can a substance exhibit both the thermal and electrical colors simultaneously? It is not probable that the same line of atoms receives an equal charge of thermal and electrical ethers simultaneously. Let us take for

XVI. The most Powerful Substances

Are those which are transparent, from the fact of their combining both the thermal and electrical potencies. The following bodies, which are transparent, are adduced in proof :

1. *Water* is the most powerful single solvent in nature.

2. *The most powerful acids* such as the Sulphuric (oil of vitriol), nitric, acetic, hydrochloric (muriatic), hydrocyanic (prussic), etc.

3. The *Alcohols* and *Drug-ethers* including chloroform, etc.

4. The most powerful *Gases* such as oxygen, hydrogen, etc.

5. The *Invisible potencies* that permeate everything such as gravito ether, electro-ether, psychic ethers, etc.

XVII. Transparent Fluids,

Though abounding in both electrical and thermal potencies, have, as a general rule, a preponderance of the electrical character. This comes from the fact that transparent substances are such as can be polarized in various directions by the light, and in order to allow of this polarization the axial or electrical principle of the atoms must be active. Faraday has shown that oxygen stands at the head of the electro-negative bodies, and *electro-negative* as we have already seen is but another name of that which, in chemical combination, is really electrical. Nitrogen and Hydrogen are also ranked as electro-negative, although the latter is placed next to the electro-positive and has its highest intensity in the thermal part. The electrical character of these gases may also be seen in the spectra of transparent substances, although hydrogen has a single red line of greater intensity than those of its electrical colors, which is a manifestation of its thermal power.

instance, the atomic lines of the cosmic ether upon which the sunlight comes to the earth and in which as we have seen the lines are arranged conversely. The ethers for red, yellow, etc., sweep thermally through one line of atoms, while those for blue, violet, etc., sweep axially through the contiguous lines and both of these come side by side *toward* the earth in the day-time, but move with a more positive power *from* the earth at night. At night, however, they do not move with sufficient force to ignite the luminelles of the atmosphere, and consequently we have a condition of shadow. If the earth's efflux forces are not powerful even at night, they must be still less powerful in the day-time, for the solar currents moving in the opposite direction must more or less impede and draw into themselves the currents from the earth

In fact the spectroscope, aided by the principles which we have already seen to be true, will reveal the electrical or thermal potencies of substances better than the galvanic battery, as it shows just the grade of electricity or thermism. Thus oxygen has its leading potency, in that grade of electricity which develops the blue, especially the indigo-blue principle, while potassium has its leading potency in that grade of thermism which developes the A grade of red. It will be found in reviewing the foregoing groups of spectra of the elements, that the great general divisions harmonize with the arrangement which electricians have adopted, although the tests of color enable us to arrive more exactly and minutely at the true character and place of each element. I will quote the two groups of elements as arranged by electricians.

2. ELECTRO NEGATIVE ELEMENTS, in which the atoms are especially powerful in the axial or electrical principle commencing with the strongest :—

Oxygen, sulphur, nitrogen, chlorine, iodine, fluorine, phosphorus, selenium, arsenic, chromium, molybdenum, tungsten, boron, carbon, antimony, tellurium, columbium, titanium, silicon, osmium, hydrogen.

3. ELECTRO POSITIVE ELEMENTS in which the atoms are on the average more wide-mouthed, more especially fitted for encasing others, less electrical and more thermal, commencing with the strongest :—

Cæsium, rubidium, potassium, sodium, lithium, barium, strontium, calcium, magnesium, glucinum, yttrium, aluminum, zirconium, manganese, zinc, cadmium, iron, nickel, cobalt, cerium, lead, tin, bismuth, uranium, copper, silver, mercury, palladium, platinum, rhodium, iridium, gold.

4. There is occasionally a little discrepancy between the estimates made in connection with the galvanic battery and those in connection with the spectroscope, but I have generally found the spectroscope, even with its present imperfections, the more correct. Thus iodine is ranked among the electro-negatives by the electricians, and yet in its spectrum the thermal colors predominate, especially the yellow. Which is correct? Looking in the U. S. Dispensatory, (Wood and Bache,) Iodine is described as having "a hot taste," and as being "excitant of the vital actions, a diuretic, diaphoretic, emmenagogue," etc., all of

which terms belong to the expansive character of thermal substances as opposed to the electrical, as will be abundantly shown hereafter.

5. The electrical character of the transparent substance *water*, has been fully shown by Faraday, although it can be so heated as to have thermism predominate. The two qualities, however, have almost an even balance, and this is not much of a point in favor of our position.

6. The transparency of the powerful acids has been mentioned. *Are acids electrical or thermal as their leading characteristic?* While acids have a certain amount of the thermal principle, as in the hydrogen which is, to a considerable extent thermal, and is an almost universal ingredient in them, or in the carbon in which thermism also is a somewhat characteristic, they always have the electrical principle, as in the oxygen, etc., more fully developed, especially if they have a distinctive acid character. They pucker the mouth, contract the skin, act as an astringent to the bowels, are cooling, quench thirst, etc., all of which show their electrical character. "Tannic acid is the chief principle of vegetable *astringents*." Acetic acid, tartaric acid, citric acid, etc., are by medical men called "refrigerants." I quote the following sentences from the U. S. Dispensatory concerning the more powerful acids, which are transparent.

"Acids have a strong electro-negative energy." (p. 801.)

"*Sulphuric acid* is *refrigerant* and *astringent*."

"*Nitric acid* (diluted) is good in *febrile* diseases."

"*Hydrochloric acid* is colorless and *refrigerant*."

"*Phosphoric acid* is tonic and *refrigerant*."

7. That acids may at times, by uniting with certain alkaline or thermal substances of the stomach or bowels, produce heat or a laxative effect is very true, but it is on the same principle that heat may be produced by a dash of cold water, in case the system has a sufficient amount of internal heat to react.

8. The electrical nature of transparent acids may be determined by chemical analysis; thus sulphuric acid as may be seen by its formula (H_2SO_4) contains 2 volumes of hydrogen which is highly thermal, to 1 volume of sulphur and 4 volumes of oxygen, both of which last have an electrical predominance, although the sulphur is powerfully thermal also. By weight the

electrical predominance in sulphuric acid seems more marked, for if we call the weight of the hydrogen 2, that of the sulphur will be 32, that of the oxygen 64. In nitric acid (HNO_3) the hydrogen weighs 1 part, the nitrogen 14, and the oxygen 48; in hydrochloric acid (HCl.) the hydrogen weighs 1 part, and the cholorine in which electricity predominates weighs 35.5; in phosphoric acid, (H_3PO_4) the hydrogen weighs 3 parts, the phosphorus 31, the oxgen 64.

9. *Alcohol* (C_2H_6O) has evidently a preponderance of the thermal or fiery element from its amount of carbon, and especially of hydrogen, although it has a goodly amount of electricity also. Hence it is called "a powerful diffusible stimulant," from its burning qualities. *Chloroform* ($CHCl_3$), from its amount of chlorine, has an electrical predominance and hence, from its cooling nature is pronounced "a sedative narcotic," (U. S. Disp'y). Ether (the common ethylic or sulphuric, $C_4H_{10}O$) is still more thermal than alcohol, from its increased amount of carbon and hydrogen, and is described as being "much more rapid in its effects than alcohol," and "very inflammable."

10. Thus, although such transparent substances as hydrogen, alcohol and common ether have a predominance of thermism, the fact that oxygen, nitrogen, water, atmosphere, chloroform, and the powerful acids which are transparent, have a predominance of electricity, clearly proves our proposition with regard to the general electrical character of transparent fluids.

XVIII. Transparent Solids.

These are such as have been polorized and crystallized by electrical forces of such power as to make them, as a genera rule, *exccedingly hard*, as in the case of diamonds, glass, rock crystal, the purer kinds of flint, etc. Congealed water, in its softer and opaque form is seen in the snow; when harder and more intensely polarized as in ice, it becomes transparent. The finer color-electricities, such as sweep so freely through transparent substances, cause greater hardness than coarser grades of electricity which are weaker, and which penetrate opaque substance. An example of this may be seen in the finer and coarser grades of carbon as exemplified in the diamond and plumbago.

XIX. Chromatic Repulsion.

All substances while under chemical influence repel contiguous substances which have the same grade of color, and tend to stimulate them into greater activity.

This is a principle of great and far reaching importance, and I invite the attention of the reader to the following proofs :—

1. Dr. Newberry exhibited before the Liberal Club of New York a plant which was grown under the ordinary white light of the sun. This was interspersed over its leaves with red and green colors. Another plant of the same kind, grown under red glass exhibited a far greater predominance of the red principle in its leaves, while a plant grown under blue glass exhibited leaves of blue-green.

2. I have concentrated upon chemically sensitive paper red, blue, violet-gray, orange-gray, etc., by means of red glass, blue glass, etc., aided by a lens. Why does the red glass produce a red impression, the blue glass a blue one, etc.? Because the red glass, for instance, transmits the red rays, and reflects or absorbs much of the other rays. These red rays drive before them and concentrate upon the paper the red luminelles of the atmosphere with which they come in contact, and must do so from the fact that an object cannot be red at all, excepting as it repels (reflects) the red elements. The same is the case with the blue and other colors. This law will apply also to the foregoing principle concerning vegetable growth.

Since writing the foregoing I have perused the most valuable work by Robert Hunt, F. R. S., entitled "Researches on Light in its Chemical Relations," and find therein recorded several examples which prove the foregoing principle, some of which I will quote :—"It was noticed by Daguerre, that a red house gave a reddish image on his iodised silver plate in the camera obscura, and Mr. Fox Talbot observed that the red of a colored print was copied of a red color on paper spread with chloride of silver." "A paper prepared by washing with muriate of barytes and nitrate of silver, allowed to darken whilst wet in the sunshine to a chocolate color, was placed under a frame containing a red, a yellow, a green, and a blue glass. After a week's exposure to diffused light, it became red under the red glass, a dirty

yellow under the yellow glass, a dark green under the green, and a light olive (blue-gray) under the blue " (p. 338). Seebeck also copied various colors on chloride of silver, Hunt copied colored maps, drawings, etc., and Niepce de St. Victor developed the yellow, red, blue, etc., by putting upon the plates the yellow, red, and blue elements to be intensified and copied by the same elements of the sunshine. These colored sun pictures were named by the last, *heliochromes*.

3. It will be fully shown hereafter that the red light and various other red objects stimulate the arterial blood which is of itself red, that yellow light and the yellow principle of various substances, although some red and orange also are active, stimulate the action of the nerves in which the yellow principle is predominant, being composed of sulphur, phosphorus, carbon, oxygen, hydrogen, potassa, nitrogen, etc. ; that the blue light increases the blue principle of the body and renders it more electrical, etc. I will mention here as corroborative of my point a few drugs, with their established potencies, as given by Dr. Hartshorne's Conspectus of Medical Sciences, and the U. S. Dispensatory, and leave the fuller explanation for the Chapter on Chromo Therapeutics :—

4. *Arterial Stimulants :* in which the red predominates as in red pepper (capsicum), ammonia (NH_3), in which the vivid red of the spectrum of hydrogen and the feebler red of nitrogen are active ; alcohol (C_2H_6O), in which hydrogen rules, also blood-root (sanguinaria), pink-root (spigelia), red-cedar (juniperus virginiana), in which hydrogen rules ; several oxides of iron in all of which red is pre-dominant, etc.

5. *Nervous and Cerebral Stimulants* consist of the fine expansive and repulsive principle of yellow as the leading principle which sometimes acts strongly upon the brain, as in opium (a yellow powder), Chloral hydrate (C_2HCl_3,OH_2O) in which the yellow principle is especially strong in the spectrum of carbon and chlorine, and even in the oxygen, etc. ; also upon the nerves of the stomach, expanding the ingesta and developing a reflex action of the nerve fluids in *emetics* such as lobelina (a yellowish liquid), the sulphates of zinc and copper, the spectra of which are prominently yellow, etc. ; also upon the nerves of the gall bladder, expelling the bile (yellow) in such a cholagogue as

podophyllum (mandrake), which is yellow, etc.; also in direct *laxatives* and *purgatives* which have an expansive and repulsive action not only upon the fœces, much of which are yellow, but upon the nerves of the visceral membranes, and include such substances as castor oil (yellowish), rhubarb (yellowish brown), sulphur (yellow), colocynth (both flowers and fruit yellow), aloes (greenish yellow), while in such mineral and saline cathartics as magnesia, magnesium sulphate (epsom salts), sodium sulphate (glauber salts), sodium phosphate, etc., the yellow color is decidedly predominant in the spectrum. The leading difference between emetics and purgatives is, that the former have more red and also act so rapidly on muscles as well as nerves, as to produce their repulsive motions mainly before leaving the stomach, while the latter do not get into full operation generally until they reach the bowels and some, aloes for instance, act mainly on the lower bowel (rectum). One reason why emetics act more rapidly and violently than purgatives, seems to be that they very generally combine more of the heating effect upon the blood, of the red or orange principle, with the nerve stimulating yellow principle, as in ipecacuanha, which has a red principle in it, sanguinaria (blood root), whose sap is orange colored and whose powder is brownish red, tartar emetic (tartrate of antimony and potassa $KSbC_4H_4O_7,H_2O$), in which the red principle of potassium and hydrogen, as well as the yellow or orange principle of the antimony, carbon, potassium, etc., are prominent in the spectrum, etc. The combination of the red principle with the yellow, reaching as it does the blood and muscular tissue as well as the nerves, causes generally an especially griping and drastic effect, both in emetics and purgatives as in gamboge (red-orange and yellow), black hellebore (rose colored flowers, yellowish white root), croton oil (pale yellow and reddish brown), etc.

6. Stimulating substances which have an affinity for the nerves of the kidneys, known as *diuretics*, have yellow as their leading principle, although the red or orange is also a very strong principle especially in the more powerful diuretics, as in tartar-emetic (yellow, red and orange), dandelion (yellow flowers, brown root), copaiba (juice "yellowish red"), Indian hemp (yellowish brown root), potassium carbonate (red and yellow spectrum), etc.

7. But the list of nerve stimulants could be extended almost indefinitely, including *Emmenagogues*, *Escharotics* (Caustics), *Rubefaciants*, *Diaphoretics*, etc., all of which have the yellow principle prominent, although these four last named, having more or less to do with exciting and warming the blood, frequently unite a large amount of the red and orange elements with the yellow.

8. The method by which the *blue* and other *electrical colors* stimulate their own cold principle and subdue the heat, will be seen in the next chapter.

9. It is proper to state here that Dr. Edward Newberry, of New York, as early as 1831, declared that yellow stimulates nervous action, pink, the nutritive system, etc., and that the color of walls, carpets, window-shades, etc., should be adapted to delicate and unbalanced persons. I am not aware, however, that, either he or any other writer has stated the law by which these effects are produced.

10. Why is the yellowish acid called *aquia regia* ($NO_5 + HCl$) the only one which can dissolve gold and platinum? Why cannot the powerful acids which are not yellow in their predominating color accomplish the same result? Is it not because the yellow is repellant of the yellow, which color is thoroughly predominant in the spectra of these two metals? Chemists state also, that nitric acid, in its more diluted and yellow condition, is much more corrosive of many metals and of the human skin, than the more concentrated and transparent nitric acid. This shows the nerve stimulating power of the yellow.

11. Melloni affirms that all bodies have a chemical coloration. "If we paint a board of the seven prismatic colors or take, which is still better, seven pieces of cloth, of the same colors as the rays, and receive the spectrum upon them, we shall find, when all the rays fall upon their own color, that the color of each is considerably exalted. If we receive the spectral image upon a red ground, all the rays will suffer diminution in intensity, except the red, which will be increased. If on the contrary it is received upon a blue ground, the blue ray will become more intense, whereas all the others will, in different degrees, be diminished."

12. One proof that colors stimulate and intensify other colors is the fact that substances which are hidden from the sun's rays

grow dim and neutral in their color principles, as is the case with soil, or with objects far down in the sea where the light cannot penetrate. "Prof. Forbes and Mr. Couch have both of them remarked that the vegetables and animals near the surface of the sea are brilliantly colored, but that they gradually lose their brightness as they descend, until the animals of the lowest zone are found to be nearly colorless. Hence we see the dependence of marine animal and vegetable life upon the solar influences to as great an extent as over the surface of the dry land." (Hunt). Prof. Forbes made experiments by which he found but a very few testacea existed as low as 200 fathoms, while at about 300 fathoms it was considered that animal life was extinct, the darkness being too great. Vegetable life ceases at 50 fathoms.

13. Having ascertained the therapeutics of color repulsions as connected with the cruder elements of drugs, we may adopt the same potencies in a finer, safer and more penetrating form, in the elements of sunlight, straining the light through red glass for warming the arterial blood, through yellow glass for animating the nerves, through purple glass for animating the venous blood, etc. But this will be explained more fully in the next chapter.

XX. Chromatic Attraction.

All substances under full chemical action tend to attract, or combine in harmonious union, those elements whose colors form a chemical affinity with their own, or at least under a chemical action which is less complete, to unite their thermal principles with the electrical principles of substances in proximity to them, or vice versa.

1. The rationale of this law which reveals a multitude of mysteries and sheds important light upon all styles of force, has already been given in the Third Chapter, which should be perused in order to the best understanding of the following. It should be remembered from the conception of atoms there explained, that the thermel and *blue-green* constitute a chemical affinity, as also do the *red* and *blue*, the *red-orange* and *indigo-blue*, the *orange* and *indigo*, the *yellow-orange* and *violet-indigo*, the *yellow* and *violet*, and the *yellow-green* and *dark violet*. I will enumerate a few facts in proof of the above law.

2. *Water.* One of the most perfect chemical combinations in

nature is seen in water. It is composed of hydrogen, whose ruling spectrum is *red* and warm, and of oxygen, whose ruling spectrum is *blue* and electrical. So great is their affinity that they are swept together about 2000 times as close as when in their gaseous condition. Having this beautiful union of contrasting elements, it readily combines with alkalies and other thermal elements by virtue of its oxygen, and with acids and other electrical elements by virtue of its hydrogen, being thus the most universal of solvents.

3. *The Sky*, as we have already seen, presents its blue appearance by virtue of its aqueous vapor, which is only an expanded form of water. But why is the sky blue as long as hydrogen must be the coloring principle, being the encasing atom which in this case must cover up and hide the color effects of oxygen? By what pleasing law has nature caused this hydrogen to give us our celestial and soothing blue instead of sending us its own flaming red which, if permanently distributed over the whole sky, would drive us blind and crazy with its exciting character? By the law of chemical affinity. The reason why hydrogen flames are red and its spectrum is so strong in the red, is that it is repellant of the red elements and consequently must, according to our law, be attractive of its affinitive color, the blue. The sky, unlike most objects, does not get its color from *reflection*, but from *transmission*, the hydrogen attracting its affinitive blue more strongly than any other color, and passing it on from the sun to our eyes, meantime repelling the red elements towards the sun. Even on the side of the sky opposite the sun, we receive the blue portion of the reflected light. To get at the color of the sky more definitely, it should be an indigo-blue much diluted with white light to correspond with the so called red of the hydrogen, which is really a red-orange, and such we shall find to be the case when we look carefully. A traveller informs me that the Italian sky, so famous for its purity has a very perceptible indigo cast.

4. The *Ocean* transmits its blue to our eyes on the same principle as does the sky, from the affinitive action of the hydrogen, meantime receiving a certain greenish tinge from the mineral elements with which its water is charged, thus making its general color in deep water, blue-green.

5. *Oxygen*, whose predominant potency is in the blue and indigo-blue, has its most powerful affinities for elements whose spectrum has great intensity in the red, and red-orange, such as potassium, hydrogen, lithium, strontium, iron, zinc, etc. So powerful is its affinity for the red elements of the atmosphere that when it predominates decidedly in any compound, it has a great tendency to impart a red or orange hue to it. Thus while ferrous oxide (FeO) is pale green, ferric oxide (Fe_2O_3), which has half as much again oxygen, is crimson ; chromium monoxide (CrO), is pale blue, chromium trioxide (CrO_3), with three times as much oxygen, is red ; manganese monoxide (MnO) is light green, red manganese oxide (Mn_3O_4) is reddish brown, etc. Other highly *electrical elements*, in which blue is a ruling color, tend towards the red when very strong, thus sulphur tetrachloride (SCl_4) is red-brown, and all acids which abound in the blue principle are tested by their facility in converting blue litmus into a red color. The influence of the oxygen in the lungs as it transforms the purple venous blood into the red arterial blood is well known and verifies our rule.

6. *Potassium* and other *alkaline elements*, in which the red of the spectrum is predominant, tend towards the blue in combinations in which they rule, thus while K_2O is white, K_4O is bluish gray ; ammonia (NH_3), combined with red litmus, turns it blue, and the alkalies generally, having their potencies in or near the red end of the spectrum, convert the same litmus into blue or indigo.

7. Count Rumford wetted pieces of ribbon and parcels of magnesia with a solution of gold, in which, of course, the *yellow* predominates. Those that were exposed to the strong sunlight assumed a *violet* hue in a few hours, while those preserved in darkness remained unchanged. This shows the tendency of the yellow, under chemical action, to affinitize with the violet.

8. The invisible thermel ray may be made visible by *cobalt blue*, which is nearly its affinitive color. By looking at the spectrum of cobalt, it will be seen that blue-green is its strongest color. "Sir John Herschel has shown us that by looking at the spectrum with a cobalt-blue glass, we perceive a ray, called by him 'extreme red,' of a crimson color, below the ordinary red ray of the spectrum. Again, throwing the spectrum on paper stained

yellow by turmeric, a ray of high refrangibility beyond the violet becomes visible, which ray is of a peculiar neutral color, and has been called the lavender (or violet gray) ray." (Hunt.) Thus, the fact that the yellow principle developes the invisible trans-violet best, while the blue-green developes the affinitive thermel better than other colors that have been tried, is a decided argument in favor of the red, having an affinitive attraction for the blue, and the violet, an affinity for the yellow. The sulphate of quinine, in which the yellow principle is powerful, and a green variety of fluor spar, etc., with more or less of yellow, are also used to render the trans-violet visible, but are able to present to the eye only the blue part of this color, the red being of so etherial a nature as seemingly to escape ordinary vision. A greenish yellow glass, colored by uranium oxide, is also used for the same purpose, as well as a tincture of horse chestnut, etc.

9. The *Germination of Plants* which has so long been a mystery, is another example of the action of color affinities. In the first place the germinating seed must be placed in the soil, away from the light, as it has been repeatedly shown by Prof. Hunt and others, that the luminous and thermal rays tend to destroy germination. As early as 1801, Victor Michellotti of Turin, stated, that "light, or that which comes from the sun" has a decided action on those germs which are exposed to it, that this action is prejudicial to them, causing total extinction of their life, if very intense. By understanding the law of atoms the cause of this seems to be apparent. The seeds or other germs of plants, are composed of oxygen, hydrogen, carbon, and perhaps nitrogen as their leading element. When the yellow rays strike the seed the same rays of the carbon and nitrogen repel them. When the red rays strike it, the red principle of the hydrogen and nitrogen repel them. In this way the leading constituents of the seed, when exposed to the luminous rays, have their repulsive energies aroused which throw off rather than receive the affinitive particles that tend to increase their mass and thus constitute growth. Besides this, these heat rays evaporate the moisture that surrounds the seed and gives a scorching effect. When the seed is placed in the soil, the luminous and thermal rays cannot reach it, 1st, because the soil, abounding as it does in thermal elements, repels them, and 2dly, the thermal rays are less penetrating

than the electrical.* Prof. Hunt says, "Light prevents the germination of seeds. Actinism (influence of blue, indigo, violet and trans-violet) quickens germination." How does actinism thus quicken it? The blue rays being able to penetrate the soil, are attracted by the red principle of the hydrogen of the seed and become more or less incorporated with it, while the violet rays, drawn on by the affinity of the yellow principle of the carbon, become incorporated with that element. But how can the carbonic acid of the air be driven into contact with the seed and be made to give up its carbon to form the new germ? In the first place we must remember that the seed absorbs hydrogen and oxygen in an aqueous form from the soil. Thus we have molecules of hydrogen and oxygen in the seed, and molecules of carbon and oxygen in the carbonic gas which the sunlight drives against the seed. The carbon, with its strong yellow and orange principle, has a powerful affinity for hydrogen with its strong indigo and violet principle, and breaking up its combination with oxygen, seizes certain atoms of hydrogen away from their atoms of oxygen, and thus we have oxygen freed on both sides, while the solidifying element of the carbon is added to the new germ. Some of the atoms of oxygen in the seed, thus set free, unite doubtless with atoms of carbon in a way to constitute carbonic gas and also become a part of the new germ. But how does the sunlight thus drive these molecules of carbonic acid into the plant? How are they to be propelled by the electrical rays such as blue or indigo or violet, whereas the yellow is its most natural principle of repulsion? The following seems to be the answer to this seeming enigma: the carbon of the air assumes the compact form of carbonic acid which exists in molecules of 2 atoms of oxygen to 1 of carbon, hence the blue principle of the latter is thus presented in abundance, acting upon which the same grade of blue in the sunlight repels it into the soil, where, reaching the new germ-plant, the carbon and hydrogen, from their powerful affinity for each other rush into union.

We may see by the above why it is that vegetable growth contains finer elements than minerals, the former receiving much of its substance from the sunlight and atmosphere, which we

* "It parait donc que la lumière rétarde la germination, et c'est pour prévenir ce retardement, que les graines semées doivent être couvertes de terre." SENNEBIER.

have already seen (Chap. Fourth, VII.) consist of finer grades of matter than the grosser earthy substances. That the carbon of plants and the coloring matter of leaves, etc., come from the sunlight and air is generally admitted by naturalists. Prof. Fownes, in his chemistry, says that the "carbon dioxide (carbonic acid) of the atmosphere is to supply to plants their carbon, these latter having the power, by the aid of their green leaves, of decomposing carbon dioxide, retaining the carbon and expelling the oxygen. The presence of light is essential to this effect, but of the manner in which it is produced we are yet ignorant." (p. 167.)

10. *Chlorophyl, or the green coloring matter of plants*, about which so much discussion has taken place, seems to find its explanation principally in the last paragraph (9). It is a waxy substance composed of oxygen, hydrogen and carbon combined in foliage much on the principle just described. If the reader will think a moment he will see that the result of this combination, under ordinary circumstances, must be green, for the oxygen, if not furnished in large quantities, must show its blue according to the principle of metachromism to be explained (XXII), and, the carbon its yellow, which combined of course make green. The red principle of hydrogen is covered up usually by the carbon, though in some plants it appears. Leaves grown under red glass will assume a red or reddish brown cast and will doubtless have an excess of hydrogen, or else an excess of oxygen whose affinitive action intensifies the red of hydrogen (see XXII, 4). Leaves that are detached or made lifeless by frost, cannot seemingly maintain the activity of their electric currents sufficiently to hold all their elements in close union, some of their hydrogen evidently escapes, leaving the carbon in the ascendency as signified by the yellow leaf, and sometimes the oxygen in predominance as signified by the reddish or red brown cast. In the daytime the growth and brilliancy of color of the leaves are greatly promoted, as the thermal colors unite with the electrical in propelling the carbonic acid against the foliage, in which the affinitive hydrogen seizes the carbon away from its associated oxygen, which latter is thus, in part, set free. Thus beautifully do nature's affinities and repulsions work to supply the great breathing world of human and animal life with the vitalizing oxygen, at the very

same time that it withdraws the noxious carbonic acid gas, or rather decomposes and then recomposes it in more delightful forms and colors. At night these processes, to a great extent, cease, although the upward movement of the earth's electricities which predominate at that time must carry some small portion of the carbonic acid of the atmosphere into the leaves.

11. The *wood and bark of trees* come principally from the same combination of hydro-carbons which are absorbed affinitively from the propulsive power of the sunbeams, although the oxygen and hydrogen of the juices and saps, together with certain elements which they hold in solution, are absorbed from the soil by the roots. The oxygen and carbon predominate over the hydrogen in the lignin ($C_{18}H_{30}O_{15}$), and other woody fibres, hence the lack of the blue coloring principle. The *bark* is composed very much of the same materials as the interior portion, but seems of too coarse a grade to be driven inside of the wood by the sunlight, or to form so complete a chemical combination as the interior ligneous part. The proof of this is 1st, that the bark is amorphous and a non-conductor of heat and electricity; 2dly, the carbon of the bark often appears in a dark or almost black state characteristic of this substance when not combined chemically, while the carbon of the interior is so chemically active as to assume more or less of its characteristic yellow, being polarized longitudinally and otherwise. This beautiful arrangement of porous and amorphous bark, protects the inner life of the tree or plant by shutting out the external cold and shutting in the internal warmth. Tyndall found that wood conducts heat longitudinally from 3 to 5 times more powerfully than does the bark from the inner side outward.

12. "Decandolle succeeded in producing the green color of leaves by the strong *light of lamps*, which we know give out a much larger quantity of yellow rays than any others: consequently it was inferred that light was necessary to the production of chlorophyl. Dr. Daubeny, however, obtained no result from the action of incandescent lime, which emits a much purer white light, producing also chemical effects in a marked manner." (Hunt.) Here we have a striking proof of the truth of the foregoing principles which easily explain the seeming anomaly. We may deduce the following points therefrom: 1st, it is not simply

the yellow principle which helps form the green of chlorophyl, but a special grade of yellow; for the light of lime (calcium) itself has a brilliant grade of yellow as will be seen by the spectrum, and yet it cannot manufacture chlorophyl; 2dly, as the light of the lamp gets its yellow color from carbon and is successful in forming the green of foliage, it shows at once that this element gives the grade of yellow which constitutes a part of this green, for carbon yellow can be repelled only by carbon yellow, according to the law already stated (XIX,) so we see at once how the carbon flames of the lamp can repel the molecules of carbonic acid into the foliage, just as the carbon grade of solar ethers can do the same thing, only much more powerfully; 3dly, the carbon grade of yellow-orange, yellow, and yellow-green must form a more direct affinity with the hydrogen grade of indigo and violet, than the yellow of calcium or other elements, otherwise these other elements would seize upon the hydrogen of the leaves more powerfully than carbon itself and thus crowd it out.

13. *Flowers* require great activity of the red or extreme thermal principle on the one hand, and of the blue or electrical principle on the other, before they or their reproductive principle can be produced. The red principle comes more directly, doubtless from the warm hydrogen as acted upon by an abundance of the rubific oxygen on the law of metachromism (XXII). "The heat radiations corresponding with the extreme red rays of the spectrum," says Professor Hunt, "facilitate the flowering of plants, and the perfecting of their reproductive principle," (in forming seeds, etc.). Priestley, Scheele and Ingenhousz have shown also that flowers consume more oxygen than any other portion of the plant." Saussure has shown that "flowers will not be developed without oxygen; that so far from giving out oxygen when exposed to sunshine in larger quantities, as leaves do, they consume even more oxygen than before."

14. *Why do many flowers incline towards the sun?* Hunt ascertained by means of experiments through different colored glass that yellow rays cause flowers to turn toward them while red rays repel them in the opposite direction. May not this be accounted for on the law of chemical affinity, the violet principle of the hydrogen especially attracting the yellow principle of carbon that sweeps along in the solar rays, while the red principle

of hydrogen, being its most active element, would be repelled by a similar red principle?

15. *The harmonic contrasts of flowers* in nature are brought about by the law of chromo-chemical affinity, as already stated. The affinities of red and blue, however, are less harmonic than those of red and green. Has nature made such a blunder as to establish a chemical affinity between two colors which are more or less discordant to the eye? Does not the blue principle of oxygen, it may be asked, ever tend to combine with the red principle of hydrogen, potassium, etc.? Yes, but not in such a way as to make discord to the eye; thus oxygen and hydrogen are combined in such a way as to form the beautiful transparent substance water, or the white substance of potassa, etc. When the three elements of oxygen, hydrogen and carbon are combined, as they are in a vast number of substances, including leaves, flowers, woods, etc., nature uses very cunning devices to bring about harmony of color. Thus in the realm of flowers we have seen that the red or hydrogen principle is very marked. Does nature make the blunder of letting the blue element of oxygen rule among the leaves and thus create a discord with a majority of flowers? No, the carbon is brought in with its yellow principle and the foliage is thus converted into a beautiful green, the harmonic contrast of red. Various plants are made to combine red and green on their leaves, many flowers such as pansies, violets, heliotropes, primroses, gladiolus recurvus, etc., have yellow centers and violet leaves, or yellow-green centers and red violet leaves. The belladonna purpureus has a violet stem and light violet and yellow petals, the painted tritonia has a violet stem and yellow flowers, the *rosy habranthus* has rose-colored petals with green center, the *babiana angustifolia* has brilliant blue graded off into pink, the spiked speedwell has indigo-blue petals and yellow-orange anthers, while almost all flowers present some element of affinitive harmony, although a large number are dressed in white, a color which harmonizes with all other colors and contains a variety of potencies.

16. *The Laws of Vision* afford a fine confirmation of affinitive attraction in colors, as Chevereul, Sir David Brewster and others have shown, that when a vivid color is looked upon awhile, and then the eye closed, the contrast of this color will appear. It

will be shown in the chapter on Vision, that there are multitudes of nervous filaments connected with the optic nerve, through which the various colors are attracted, on the law of chemical affinity, a red filament, for instance, receiving its affinitive blue color of the sunlight, a filament with a violet potency receiving the yellow, etc. This is in harmony with all laws of color combination, and will at once explain chromatic phenomena about which very absurd theories have been formed. In the following account of a careful experiment given by Sir David Brewster, almost the exact color affinities are presented, which have already been given in the foregoing matter, the law being that when an orange color is seen with an open eye, it is because it has been received through the nerve filaments that have the indigo potency, which being thrown into rapid vibration thereby, will be apt to convey the impression of indigo upon the sensorium when the eye is closed, and so with the other colors :—

" I took advantage of a fine summer's day when the sun was near the meridian, and formed upon a white ground, a brilliant image of his disc by the concave speculum of a reflecting telescope. Tying up my right eye, I viewed this luminous disc with my left eye through a tube, and when the retina was highly excited, I turned my left eye to a white ground and observed the following spectra by alternately opening and shutting it :—

Spectra with left eye open.	*Spectra with left eye shut.*
Pink surrounded with green.	Green.
Orange mixed with pink (red-orange).	Blue (Indigo-blue).
Yellowish-Brown.	Bluish Pink (red-violet).
Yellow.	Pinkish-blue (violet).
Pure red.	Sky blue.
Orange.	Indigo.

In the above a slight error results in the first line, from the fact that two colors stand together. Pink is virtually red, mixed with a little white, but below, where he viewed the pure red alone, he gives *sky blue* as the subjective color-effect when the eye was closed. The subjective color for yellow he calls "pinkish blue," which is but another name for violet—that for "orange mixed

with pink," which is another way of describing *red-orange*, he finds to be "blue," but as he has called that for pure red, blue, this evidently must be a different shade of that color, and so I have considered it indigo-blue in harmony with my affinitive scale. The words in parentheses are my own.

17. *Inflammatory conditions of the human system* and an excess of arterial blood come from too great a predominance of the red or heat principle, and according to the law of chemical attraction, those substances which contain a goodly share of the blue will tend to blend in affinitive cooling and harmonious action with such conditions, Some of the cooling or anti-inflammatory substances are as follows:

Aconite, "flowers dark violet-blue"—"lessens the pulse."

Flax-seed (Linum)—"flowers blue, seeds brown externally, internally yellowish white—emollient and demulcent."

Prussian Blue—"A tonic and febrifuge."

Sage (Salvia), "blue flowers," "soothing in fever," etc.

Dilute Sulphuric Acid. The blue of its oxygen and sulphur predominant. "Tonic and refrigerant."

18. *Nervines, Anodynes*, etc. Inasmuch as *nervous excitement* is aroused by the yellow principle aided by the orange and red, so the opposite principle for *soothing the nerves* must come from its affinitive violet principle, aided by the indigo and blue. Some examples are as follows:—

Digitalis purpurea (Foxglove)—"has purple flowers, green powders—is narcotic and sedative."

Belladonna, "purplish stems, violet colored juices, reddish brown root"—"is powerfully narcotic, diuretic," etc.

Potassium bromide, has certain soothing effects from the blue and violet indigo of bromine, and the violet of potassium—has also some irritating effects from the red of potassium.

Aconite, "violet-blue flowers," "nervous sedative and anodyne."

19. *Astringents.* We have seen that laxatives, purgatives and emetics have a predominance of the yellow principle, and, especially when drastic and exciting, a certain amount of the orange and red; in other words they appeal to the nerves and tissues in a repellant and expansive way, and consequently, must be thermal in their nature. It is quite evident, then, that the affinitive principles of violet, indigo and blue must have the

balancing, soothing and cooling electrical properties to offset this effect. To prove that such is the case, as ascertained by medical practice, I quote a few drugs, asking the reader, however, to remember that *the blue and violet atoms are sometimes so covered up by the encasing red and yellow atoms that a few substances, especially those which are red, or dark red, or yellowish, or reddish brown, may, contrary to their external appearance, be predominantly electrical, as is the case with tannic acid, kino, etc.* :—

Geranium. "Flowers violet, root umber brown, internally reddish gray," "a powerful astringent."

Lead (blue gray) with its salts, strong in indigo, or violet indigo : "Sedative and astringent."

Acids, in which oxygen figures with its powerful blue, indigo-blue and violet-indigo potencies.

Galls. (galla). The best are externally of "a dark bluish or lead color," "internally whitish or brownish—with powder of yellowish gray." "Astringent."

Pure *Tannic Acid* ($C_{27}H_{22}O_{17}$), is a very light bluish yellow. "The chief principle of vegetable astringents." It may seem singular that tannin apparently departs from the more common rule, by being strong in thermal qualities, but when we remember that oxygen is the most intensely electrical of all elements when in combination, that hydrogen is also powerful in the blue-green, indigo and violet, and carbon itself has a considerable eletrical potency, we may more readily understand this seeming anomaly. Besides this the electrical potency of a substance itself becomes much more active by union with a fair amount of thermism as shown from the nature of atoms.

Alum, ($AlK(SO_4)_2$) bluish and translucent. "Astringent," "allays nausea and vomiting" in small doses.

Kino—"dark red color"—"astringent."

Logwood—has "blue-black variety of tannin"—"astringent."

There are conditions of the system in which the electrical colors themselves act with heating, or laxative, or emetic power, but this power does not reside in the electricity itself, but in the thermal elements within, which are stimulated to new action thereby.

20. *Affinitive sunlight.* Having ascertained the affinitive character of the colors in the coarser drug elements, we may be

assured, from the infinite unity of nature's laws, that the same principles rule in the material of sunlight, for as we have already seen, the different colors of the sunlight result from actual materials, as well as from vibrations. When a human system has a predominance of nervous and vascular excitement, sunlight strained through violet, or blue, or indigo colored glass, has a remarkable affinity for such conditions, and brings about harmony and health in the suffering patient, as will be seen in cases of neuralgia, nervous irritation and inflammatory diseases, which will be enumerated in the chapter on Chromo-Therapeutics. Dr. Ponza, Director of the Lunatic Asylum at Alessandria, in Piedmont, cured madmen by placing them a short time in a blue or violet room, the glass and walls being of the same color. Madmen generally have the yellow principle over-active in their excited nerves and the red principle too violent in their heated blood, hence the philosophy of employing the affinitive blue and violet for balancing conditions. One of the doctor's patients "affected with morbid taciturnity, became gay and affable after three hours stay in a red chamber; another, a maniac who refused all food, asked for some breakfast after having stayed twenty-four hours in the same red chamber." This is another verification of our principle, and tends to show that *harmony cannot be brought about until nature's affinities are satisfied.* A despondent, atonic condition, is very apt to result from an excess of venous blood, in which the blue principle predominates, hence the importance of red light in such cases. These different colored rays may be passed down upon a person through red, blue, violet or other colored glass, according to the condition of the system. Violet rays would be unequaled as a nervine if they could be obtained pure, but as this color is too exquisite for any known materials to impart exactly, some shades of blue glass, as will be explained in the next chapter, will transmit both violet and blue.

21. *Photography.* Photographic paper, which is coated with silver nitrate, reveals the affinitive action of sunlight upon this sensitive salt of silver. What are the colors which, under chemical action, should be attracted from the sunlight into silver? We see by the spectrum of silver that the yellow is the ruling color and yellow-green is also very active. The affinities of these would be violet and dark violet, reaching somewhat into

the shadowy trans-violet. Prof. Robert Hunt has shown the strong chemical action of silver upon the dark trans-violet section of the spectrum. Does not this show at once why it is that when silvered paper is exposed to the sunlight it immediately receives a coating of dark violet-gray, attracting not only the violet elements but the dark rays above the violet? When a sufficient quantity of these violet and sombre rays are thus deposited, it becomes dark, and finally almost black. As long ago as 1801, Ritter found that "the chloride of silver darkened rapidly beyond the violet extremity of the prismatic spectrum; in the violet ray it was less darkened, still less in the blue; below which ray the power of darkening diminished rapidly." (Hunt.) Some facts showing that *Shadow is an entity* are given in Chap. Fourth, XVIII.

22. *Homeopathy.* Truth demands, in connection with this principle, that I should say a word in favor of Homeopathy, and also a word in criticism of its fundamental principle as explained by its followers. Hahnemann seems to have "built wiser than he knew," in the practical applications of the exquisite forces of nature, as the process of triturating a drug and bringing its atoms abundantly into collision with the subtile elements of the atmosphere, enables it, by chemical affinity, to attract to itself a grade of potencies far finer and more penetrating than those connected with the drug in the crude form. (See Chap. First, XV, and Chap. Fourth, VII, 3.) And yet in his theory of *similia similibus curantur* he goes counter to one great law of nature which is, that *all free interaction of molecules of various kinds, develops more or less of chemical union, and chemical union is never a combination of similars, but always of dissimilars.* If, then, the drug by being triturated attracts a contrasting element, a red principle in the drug for instance attracting a blue element from the atmosphere, which becomes more and more potent by being well triturated, how can it be said that this blue element has the same kind of potency with the original red drug, and will develop a similar disease or similar therapeutical effect? Let us take a case in actual practice. We wish to cure a certain man whose face is flushed with the red heat principle, his system is inflammatory generally, and his arterial blood over active and on fire. Now to attempt to cure

such a case by applying the red drug direct would be like adding fire to fire, for we have already learned how completely every color tends to stimulate and increase its own grade of color. Here then comes the advantage of trituration which attracts the delightful and cooling blue principle as the balancing element, and our patient finds relief, so that disease is cured not on the *similia similibus* plan, but rather on the law of *similia dissimilibus*. This is really a philosophical method of reaching a true law of cure, for disease is generally a one sided condition of things that requires the other side as an affinitive principle to secure the harmonious equilibrium which means health, and if we find a drug which in its crude state will produce a disease similar to one that a patient may have, we find one which, when diluted and well triturated, will act on the opposite principle and tend to balance and destroy it. Homeopathy, then, in reality, employs the principle of *similars* only as a starting point to arrive at the principle of *dissimilars*. By the term *dissimilars* I do not mean *contraries*, but rather *contrasts, complements, chemical affinities*. (See Chap. First, XXIX, etc.)

A case like the following may seem to justify the Homeopathic principle. An invalid of quite a different type from the one whose example I have already given, is to be treated. He is pale, emaciated and cold, especially in his extremities, and is overstocked with the blue instead of the red principle, having blue veins, blue eyelids, and bluish finger-nails, and being especially deficient in oxygen, a great leading rubific element. This condition is more common with women than with men, especially as their blood is more poorly oxydized from their in-door life, and being deficient in oxygen cannot well attract the affinitive red of the hydrogen. Our patient, we will say, has a cold, dormant system generally, but the gastric membrane happens to be too hot and consequently is inflamed. What shall be done for him? Our other patient could have endured the blue light over the whole body, or cold baths or a cool wet compress over his gastric membrane, but this one has no heat to spare, and should be treated on quite another plan. He might receive advantage from the blue glass over the stomach, where the heat is, but not elsewhere, unless it be the head. Cold water should not be used even over the inflamed locality, for his system is already nearly

paralyzed with the cold principle. A hot compress or fomentation would evidently be suitable, for then the thermal meeting the thermal would repel heat to other parts of the system, on the principle that "similars repel." Is this, then, on the homeopathic principle? Apparently so for it is meeting heat with heat. With a little closer examination, however, we find that the reason heat is better, is because the system generally is cold, and we are really meeting cold with heat, to do which the most effectually, the limbs and extremities should also be warmed with red light, red flannels, or with the friction of a warm hand, or at times with water as hot as can be endured for the feet, ending off with a brief dash of cold water. "But ah!" says the objector, "you advocate some cold water for a cold after all, and must come over to the *similia similibus* plan at last." Let us see again. The brief cold dash or sprinkle succeeds the longer hot bath on two accounts; 1st, in order to close the pores by means of the contracting principle of cold, and thus shut the heat in, and 2dly, to produce a heat re-action by appealing to the interior thermal principle with the electricity of cold water, with the understanding however, that if the patient is so very cold and lifeless as not to be able to get up this re-action it must be used very sparingly or not at all. Thus we see that all nature in action tends towards this ubiquitous law of chemical affinity which is of supreme importance as being the balance wheel of the universe, for without it there would be nothing to prevent the forces of nature from rushing to the most violent extremes and working universal ruin. Homeopathy, then, deals with *similars* only so far as will enable it to find a drug around which to collect a *dissimilar principle* through trituration and chemical affinity with the fine elements of the atmosphere as a balancing principle by which it may bring about harmony to diseased human systems. Considered in this light, it has much that is philosophical and beautiful, but considered in the light in which its followers are quite apt to represent it, it would be baneful in its effects.* These re-

* Hahneman states as confirmatory of the Homeopathic principle that "burns are cured by approaching the fire, frozen limbs by the application of snow or very cold water; inflammations and contusions by distilled spirits," etc. This is plausible, but simply shows that heat repels heat as in the using of heat rays to soothe a burn, or alcohol to check an inflammation, and those who have studied the working of atoms

marks are not made for the sake of criticising homeopathy, but to show its advocates that they really practice on a grander principle than they claim for themselves.

XXI. The Material of Sunlight.

1. We have already seen from abundant facts and deductions that the different colors of sunlight consist not only of fine solar ethers of different grades, but of the vibrations of atmospheric and other atoms through which they pass. Having learned then that the solar ethers are substances subject to chemical repulsions and attractions equally with all other substances, capable of being collected on chemically prepared paper or plate, and consisting of several fine grades of heat and several fine grades of electricity, with the superiority over other kinds of heat and electricity of being of the right fineness to ignite the atmospheric luminelles, and thus give us the all revealing power of light, it is proper now that we should take this light to pieces and see what it is made of. This, strange as it may seem, is possible to do, after having acquired the philosophy of the solar forces, aided by the revelations of the spectroscope, for each one of the Fraunhofer lines displayed by the spectroscope signifies the presence of some particular element. Thus the D grade of yellow-orange, more commonly called yellow, signifies the presence of sodium, as no element in the whole world, except sodium, is able to give the double sodium line called D. The C grade of red-orange, com-

will see that the reactive law of heat brings a certain amount of cold after the heat rays are removed, from starting the axial spirals into action. On the same principle snow is sometimes used momentarily for frozen hands. Being electrical, it attracts the affinitive thermal elements within and draws thus the finer life heat to the surface, which is more potent than the cruder heat of fire. Hahneman's central principle, as stated by himself, is the following: "*In order to cure gently, quickly, unfailingly and permanently, select for every case of disease a medicine, capable of calling forth by itself an affection similar* (ὁμοιον παθος) *to that which it is intended to cure.*" This is correct as we have seen when the drugs are triturated and made to attract their contrasting affinitive elements, but otherwise false. A man's hand having become frozen by having it in ice water 15 minutes, he would literally follow Hahneman by holding it in snow 15 minutes, as that works in a similar way. A man's mouth has become blistered by a spoonful of boiling mush; on this principle he should immediately take a spoonful of boiling syrup, as it will produce a similar disease. Hahneman would have demurred, and did demur, at such applications of his theory, but are they not logically correct? Nevertheless he was a grand thinker and contributed to the world's upbuilding. Broad minds, however, will accept this and still other principles, as the New York Homeopathic Association have lately done.

monly called red, signifies the presence of hydrogen ; so also does the F grade of blue-green, the G grade of indigo and the H grade of dark violet. All elements that are analyzed by the spectroscope, show some luminous lines more or less refracted according to the fineness of their atomic parts. The elements of the sun, however, cast dark lines in the spectrum, which signifies that they are first driven outward by the great heat from the surface of that body and meeting the same elements in the solar atmospheres are driven back according to the principle already explained (XIX), thus causing slight vacancies in their spectra, which appear as somewhat dark lines. It must not be inferred from this that no part of these elements succeeds in reaching the earth as sunlight, for several reasons, 1st, the sun being our parent sphere as we have seen, must have the same elements as those of our earth and hence its emanations must come from these elements ; 2dly, the tremendous heat of the sun must throw up some distance from its surface an atmosphere of heavy and crude elements including the grosser portions of metals, etc. This atmosphere intercepts the grosser part of all other similar elements which are projected towards the earth from the sun's surface, thus causing the Fraunhofer lines, but cannot intercept their finer emanations which, being drawn into the atomic spirillæ, are passed on to our atmosphere, and thus give us the effect of light. We have seen (Chap. Fourth, VII,) that the different elements have their finer and coarser atoms, the finer of which being more volatile are being radiated into space. The atoms that form the ethers of sunlight must be so fine as to be able to sweep through the cosmic ether and the atmospheric oxygen, nitrogen, etc., as well as through all transparent substances and into all substances which have absorptive affinities. That fine emanations from the sun's elements do penetrate the chromosphere and pass on to us in the form of sunlight we have already seen, in the fact that carbon, oxygen, hydrogen, etc., are driven by the sunlight into the plants, or into the germs when below the soil, or into chemically prepared paper, plate, etc., and the fact that they are thus driven shows that the same kind of elements must exist in the sunlight itself, for it takes carbon to repel carbon, oxygen to repel oxygen, etc., on the law that *similars repel*," as illustrated in XIX. If anything

else but sodium could reflect the D grade of yellow-orange or anything but potassium the A and B grade of red, then our law would prove false, but such a thing has never been known. Each of the elements has certain exactly defined grades of color which it reflects when made luminous, and which no other substance can reflect. Fraunhofer observed about 590 lines and Sir David Brewster still later, 2000 dark lines in the solar spectrum, as caused by the luminous elements of the sun's atmosphere. Besides these there are the intervening luminous lines which must be the manifestation of various elements. According to Ángström, hydrogen gives out 4 color lines, nickel 33, cobalt 19, calcium 75, copper 7, iron 450, titanium 118, sodium 9, etc. This shows that such elements as iron and titanium must be wonderfully diversified in the sizes of their spirillæ to be able to reflect so rich a variety of colors. Instead of there being simply 7 colors as some suppose, there are 2000 different grades of color required to represent the color potencies of the metals of the atmosphere, and these constitute but a small part of the degrees of color in an extended solar spectrum. Those elements of the sun which, on being radiated from its burning surface would encounter no similar elements in the solar atmospheres, would pass directly on to us, and would cast no lines in the spectrum.

2. Since writing the foregoing, a remarkable paper has been read before the American Philosophical Society by Prof. Draper, one of the foremost of living authorities on the subject of light, in which he speaks of the discovery "of oxygen, and probably nitrogen, in the sun," as revealed by photography. This paper was read on July 20th, 1877, and published in the Journal of the Franklin Institute for August, in which the following language is used :—"Oxygen discloses itself by bright lines or bands in the solar spectrum, and does not give dark absorption lines like the metals. We must therefore change our theory of the solar spectrum and no longer regard it as a continuous spectrum, with certain rays absorbed by a layer of ignited metalic vapors, but as having also bright lines and bands superposed on the background of a continuous spectrum. Such a conception not only opens the way to the discovery of others of the new metals, sulphur, phosphorus, selenium, chlorine, bromine, fluorine, carbon, etc., but also may account for some of the so-called dark lines,

by regarding them as intervals between the bright lines." *These grades of oxygen and other substances which are sufficiently fine to be transmitted through the spirillæ of the solar atmospheres doubtless come on to the earth with a brilliant light, and produce luminous lines in the spectrum, while the coarser grades are reflected back and thus form the dark lines of the spectrum.* Is not this another mystery cleared up by the etherio-atomic law, and exactly what should be expected with the two grades of reflected and transmitted light?

3. I will draw up a list of the *materials of colors* so far as contributed by 20 important elements, including 16 metals which the spectroscope has discovered in the sun's atmosphere, and the four metalloids, oxygen, hydrogen, nitrogen and carbon, which have so much to do with light, and which must certainly form a part of the solar ethers from their universality. The names of the metals are sodium, calcium, barium, magnesium, iron, chromium, nickel, copper, zinc, strontium, cadmium, cobalt, manganese, aluminum, titanium, rubidium. Hydrogen also exists in vast quantities in the solar atmosphere, as has been seen. Doubtless many more, if not all of the elements, have something of their finer emanations represented in light. Carbon we know forms a part of light and is imparted to plants by the sun's rays.

3. *Materials of Red-light:*—Nitrogen, oxygen, barium, zinc, strontium, cadmium, rubidium.

4. *Materials of Red Orange Light:* — Hydrogen, oxygen, nitrogen, calcium, barium, iron, copper, strontium, cadmium. This color, in common parlance, would pass for red, and constitutes a refined grade of that color.

5. *Materials of Orange Light:* — Oxygen, calcium, iron, nickel, zinc, cobalt, rubidium, aluminum, titanium.

6. *Materials of Yellow-Orange Light:* — Carbon, nitrogen, sodium, nickel, zinc, cobalt, manganese, titanium. This would often pass for yellow with those who are not discriminative.

7. *Materials of Yellow Light:* — Carbon, nitrogen, oxygen, calcium, barium, iron, chromium, nickel, copper, zinc, strontium, cadmium, cobalt, manganese, aluminum, titanium.

8. *Materials of Yellow-Green Light:* — Carbon, nitrogen, oxygen, sodium, calcium, barium, magnesium, chromium, nickel, copper, strontium, cadmium, cobalt, rubidium, aluminum, titanium.

9. *Materials of Blue-Green Light:*—Carbon, nitrogen, hydrogen, sodium, iron, nickel, copper, zinc, cobalt, manganese, titanium.

10. *Materials of Blue Light:* — Oxygen, nitrogen, barium, magnesium, chromium, nickel, copper, zinc, strontium, cadmium, cobalt, manganese, aluminum, titanium.

11. *Materials of Indigo-Blue Light:*—Oxygen, nitrogen, iron, calcium, manganese, titanium.

12. *Materials of Indigo Light:*—Oxygen, hydrogen, carbon, iron, chromium, copper, strontium, titanium.

13. *Materials of Violet-Indigo Light:*—Oxygen, nitrogen, carbon, iron, calcium, cobalt, rubidium, manganese, titanium.

14. *Materials of Violet Light:* — Nitrogen, oxygen, barium, iron, strontium, manganese.

15. *Materials of Dark Violet Light:*—Hydrogen, calcium, aluminum.

16. There is a great intensity, as well as quantity of reflecting power in the range of the yellow and its kindred yellow-green and yellow-orange as the leading principle of luminosity, by means of which the universe is revealed to the eye of man. It occurs to me that the reason why the yellow is the most luminous of colors is that its luminelles are of that golden medium size which are not so coarse that the solar ethers fail to make them incandescent, as in the case of the trans-red, nor so fine as to give out waves too small to make an impression upon the sensorium, like the trans-violet. The blue principle, including the indigo, is also strong and intense as the most prominent realm of chromo-electricity, or in fact of the other electricities which tend to manifest themselves in some hue or shade of blue. Magnetic substances are always strong in the blue as well as the still finer grades of electricity represented by the indigo or violet, as in iron, oxygen, cobalt, manganese, chromium, etc. The *red*, especially the finer grade of red, more properly called red-orange, is not imparted by as many substances as some other colors, but by those which are ever and everywhere abounding, such as hydrogen, oxygen, nitrogen, etc., so we are not left to perish with the cold. The trinity of colors, the red, yellow and blue, finds representation in the three great elements of Hydrogen, Carbon and Oxygen, which constitute so much of the world, including the

whole or a large portion of the sugars, gums, starches, ethers, alchohols, many acids and much of the substance of the vegetable world.

XXII. METACHROMISM.

1. *Metachromism, or the phenomena of color change in connection with chemical combinations,* has been a mystery for ages. Why it is, that, when certain elements are combined, both lose their original color, as in the union of copper and oxygen which forms the *black oxide of copper,* or why the union of certain other substances in equal parts exhibits the color of one and obliterates that of the other, as in common salt, in which the white color of the sodium appears, while the greenish yellow of the chlorine becomes invisible; why acids redden blue litmus paper, or why alkalies turn red litmus paper blue; why oxygen sometimes appears with its characteristic blue when combined with some other substance, or *yellow,* when combined in larger proportions, or *red* when used still more largely, the blue becoming more and more departed from as it prevails more largely, these and similar questions might well nonplus the chemists until the laws of chemical affinity, as founded upon a correct knowledge of atoms, have been developed. Armed with this atomic key, metachromism can be made a science, and the convertibility of forces be more and more understood.

2. *In binary compounds, in which thermal and electric atoms alternate with each other, the color of the substance thus formed is usually that of the thermal or basic atom.* The reason of this is that the more thermal atom being broader mouthed, encases the more electric atom and hides its color spirals. (See Chap. Third, VII, also XXXVII). I quote a few of the many examples, the basic atoms being white unless designated:

Potassium Iodide (KI), white. Iodine is blue-black.

Sodium Chloride (Salt, NaCl), white. Chlorine, is greenish yellow.

Strontium monoxide (SO), white. Oxygen is colorless.

Calcium, yellowish white. *Calcium monoxide* (Lime, CaO), do.

Thorium, gray. *Thorina,* or *Thorium Monoxide* (ThO), gray.

Magnesium, yellowish white. *Magnesia* (MgO), do.

Zinc, bluish white. *Zinc monoxide* (ZO), do.

Mercurous Chloride, or *Calomel* (Hg_2Cl_2), white.

Water (H_2O), transparent, as are both of its component gases. "The chlorides of sodium, lithium, strontium and copper," says Tyndall, "yield the same spectra as the bases themselves," and the reason of that is that the heat has not as yet been made sufficiently great to overcome the powerful chemical affinity of chlorine for the encasing metals, hence they have not been separated in spectrum analysis.

3. *Some binary compounds which are usually represented by chemists as uniting, by single atoms of each element, evidently unite by twos of each, as both colors become visible, which could not be the case if the atoms alternated singly.* Thus, in what is called *gold monoxide* (AuO), if the atoms should alternate singly, the oxygen atom would be encased in the gold, and consequently only the yellow color would appear. But its color is in reality green. How account for that. If two atoms of gold should appear together, giving their *yellow* effect, followed by two atoms of oxygen, only one of which would be encased in the gold while the other would give its *blue* effect, we can at once account for the green of the compound, as the yellow and blue constitute green. It would seem more proper, then, to consider this a *copper monoxide* or *black oxide of copper* (CuO), which should be a yellowish red if its atoms alternate singly, but if they alternate doubly, we have the yellow and red principles of copper visible and the blue principle of oxygen left visible, which would account for its black or brownish black color, as these principles combined will produce black, or brown, or gray, or white, according to the proportions of each color. This then would make it a cuprous dioxide (Cu_2O_2). Such compounds as the following observe the same law:—

Platinum (yellow-potency, etc.). *Platinum monoxide* (PtO), black.

Palladium (yellow, etc.). *Palladium monoxide* (PdO), black.

Tin (orange, yellow, etc.). *Tin monoxide* (SnO), black powder.

Fig. 168 will throw a little farther light on the joining of atoms in which an alternation of twos is supposed as the monoxide of copper.

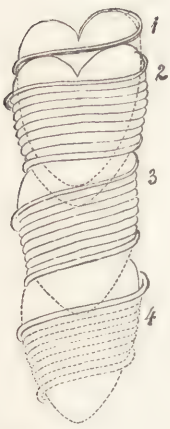


Fig. 168. Combined Atoms.

1 and 2 are the broader atoms of copper, 1 being encased in 2 and consequently losing the effect of its color spirals, while in the case of 2 we have the color spirals complete, which must reflect to the eye the reddish orange color peculiar to copper. 3 and 4 are atoms of oxygen; 3 is too narrow to receive 2 fully, consequently the color-spirals of 2 are not concealed. 4, being another narrow atom of oxygen, cannot encase 3, consequently we have the color effects of the oxygen atom 3, which, when combined with the copper color of 2, will give a dark effect, that is sometimes called *black oxide of copper.* 4 is encased by the next atom which is copper, and consequently its color effect is lost. Thus we have half the atoms of each element which produce color effects, and so get the combined effect of both. In the same way we may suppose the yellow atoms of gold to combine with the blue atoms of oxygen to produce a green effect.

4. Progressive Color Change.

As the electric elements in a binary compound predominate more and more over the thermal or basic elements, the color of the compound tends towards the red end of the spectrum, passing perhaps from the blue to the yellow-green or yellow, then to the orange, or red, or reddish brown in the outer verge of the red. Thus

In Chromium sesquioxide (Cr_2O_3) the color is green.

In Chromium dioxide (CrO_2) the color is yellow-green.

In Chromium trioxide (CrO_3), the color is red.

In the above sesquioxide the electrical element of oxygen appears in quantities half as great again as the thermal base chromium, in the dioxide twice as great, in the trioxide three times as great. Other electrical elements such as chlorine, sulphur, etc., follow the same general law, as will be seen below in the list of examples. But first what is the explanation of this mystery? In the green above, a certain amount of the blue of the oxygen combines with the yellow of the chromium; in the dioxide this

blue fades into the yellow-green in which the yellow predominates; while in the trioxide it is entirely swallowed up in the red.

It will be seen by examining the structure of the atom, Chap. Third, VII, 1, 3, that the dark-violet and violet spirals are the highest up on the atoms, and thus must be the most external at the vortex, the very point to be first struck by the impinging atom which enters this vortex. Is it not evident then that the atoms of oxygen which receive the neighboring atoms with some force must first have the dark violet and violet spirals agitated by the pressure? But when the dark violet spiral is agitated, its affinitive spiral the yellow-green must respond to it, and when the accumulated oxygen brings force enough to drive in the atom a little farther until the pressure comes upon the violet spiral, it is started into motion and by reaction kindles the affinitive yellow into new life. Suppose now we add a little more oxygen still, until the axial force becomes great enough to drive the atoms against the indigo and blue spirals which are especially active in oxygen and other electrical atoms. These at once start the affinitive orange and red into action and hence give the red effect to the compound. But now the question may arise, why do not the violet and blue show also? Because under sufficient pressure the atoms must wedge up against the blue and other axial spirals so closely as to prevent their being repellent of the blue and violet elements, and yet this very pressure must have that reactive effect on the yellow and red portion of the same spirals which will intensify them. The red and other thermal colors have an especially good chance of becoming visible as they connect directly with the red and other thermal spirals of the encasing atom, which are not concealed by the contiguous atoms. I will now quote a few examples as corroborative of the foregoing law:—

Nitrogen monoxide(N_2O), transparent.
Nitrogen trioxide (Nitrous oxide gas, N_2O_3), red-orange.
Nitrogen tetroxide (N_2O_4), red.
Bismuth trioxide (Bi_2O_3), straw-yellow.
Bismuth pentoxide (Bi_2O_5), reddish powder.
Lead monoxide or Litharge (PbO), straw-yellow.
Red Lead or Triplumbic tetroxide (Pb_3O_4), red.
Lead dioxide or puce (PbO_2), reddish brown.

Tin sesquioxide (Sn_2O_3), grayish.

Tin dioxide (SnO_2), yellowish.

Gold monoxide, or Aurous oxide (AuO), green.

Gold trioxide, or Auric oxide (AuO_3), reddish brown.

Gold monochloride (AuCl), yellowish white.

Gold trichloride ($AuCl_3$), red crystals.

Iron monoxide, or Ferrous oxide (FeO), "pale green color, speedily becoming red by absorbing oxygen from the air."

Iron sesquioxide, or Ferric oxide (Fe_2O_3), red.

Iron dichloride, or Ferrous Chloride ($FeCl_2$), green.

Iron trichloride, or Ferric chloride (Fe_3Cl_6), red.

Ferrous iodide (FeI_2), pale green. Iodine becomes electrical when favorably combined.

Ferric iodide (Fe_2I_6), yellowish red.

Gray oxide of Mercury (Hg_2O), a sub-oxide.

Monoxide of Mercury (HgO), or red precipitate.

Cobalt dichloride ($CoCl_2$), rose red solution.

Cobalt trichloride ($CoCl_3$), dark red brown.

Molybdenum disulphide (MoS_2), light blue-gray.

Molybdenum trisulphide (MoS_3), black (blue and orange).

Molybdenum tetrasulphide (MoS_4), red.

Sulphur monochloride (SCl), yellow-orange.

Sulphur tetrachloride (SCl_4), red-brown.

Potassium monoxide, or potassa (K_2O), white.

Potassium tetroxide (K_2O_4), orange.

Potassium monosulphide (K_2S), reddish-yellow.

Potassium disulphide (K_2S_2), orange.

Potassium pentasulphide (K_2S_5), dark red-brown.

Chromous chloride ($CrCl_2$), is first obtained "as a white foliated mass which dissolves in water with great elevation of temperature, yielding a blue solution, which, on exposure to the air, absorbs oxygen with extraordinary energy, acquiring a deep green color." (Fownes' Chemistry, p. 437). The present law will show why it is that oxygen can thus produce a green effect with chromium, but a red effect with iron, etc. The red principle of Chromium, is so inert (see spectrum), that all the blue potency of oxygen cannot make it visible, whereas being active in iron, a very little oxygen can bring it into play, as even the sesquioxide of iron is red. In lead the red principle is still

more active, requiring only one third more atoms of oxygen than of lead to develope it, as in *red-lead* (Pb_3O_4).

Under this law, too, it becomes quite obvious why acids will redden blue litmus paper, as all acids abound in oxygen, or at least in some element with predominating blue potencies. It becomes obvious, too, why the arterial blood is made so red by the large amount of oxygen it contains, while the venous blood, which has much less oxygen, is more blue. A great mystery is thus solved, for otherwise we might conclude that oxygen is a great heating principle, whereas it simply developes the heat in the opposite affinitive atoms, while its own cold-producing principles are held in abeyance in this and many other cases by these metachromic laws of combination, while in the venous blood a smaller amount of oxygen has its cold blue principles so aroused by the thermal atoms with which it is connected, as to make it a colder fluid than the arterial blood. We know that arterial blood is warmer than the blood of the veins, aside from the fact of its redness, for those in whom it predominates have a rubicund appearance, greater warmth of body, and are more subject to inflammation, fever, etc., while those in whom the venous blood predominates are more cold and dormant in their action. The rubific character of oxygen under similar circumstances explains a very common tendency in flowers to become red, as they are known to have large amounts of oxygen, while common green leaves get their blue principle from a smaller amount of oxygen, whose blue potencies have been developed by the affinitive red of the hydrogen.

5. When *Alkaline* or *Thermal Elements* increase in quantity, as compared with the electric elements in binary compounds, the tendency of the color is toward the violet end of the spectrum. Thus in the increase of sodium we find that Na_2O_2 is yellow, while Na_4O is blue; so in potassium we find that K_2O_4 is chrome yellow, while K_4O is blue gray; also in CrO_3 we have the red, while in Cr_2O_3 we have green. It is well known that when litmus paper has been reddened by acids, potassium and some other alkaline substances will bring back the blue. This law is much like the unwinding of the last law. We may say, why does not the red principle of the potassium manifest itself, instead of tending towards the blue when it increases? Because

if several potassium atoms occur together, they will encase each other, and hide the red spirals, and yet the axial portion of the same red spirals, constituting their chemical affinity, blue, will be rendered active and will especially excite the blue principle of the oxygen atoms.

XXIII. Proofs of Other Octaves of Color

Beyond that which is seen by the ordinary vision. Some of these are as follows :—

1. There is a large portion of the sun's rays both above and below the ordinary visible spectrum. Müller says the rays extend below the red more than two octaves. To show the existence of one of the octaves above the visible spectrum, I quote the following from Prof. Roscoe :—"It is perhaps worthy of mention that the wave lengths of the solar lines L, O, Q, are, within the limits of observational error, half those of the lines A, B, C, as seen from the following table," in which the figures give the length of the waves in ten-millionths of a millimetre :—

	Name of observer.	Length of wave.	Half of wave length.	Observed by Mascart.
A	observed by Ångström	7612.1	3806.	3819.1 L.
	" " Vander Willigen	7633.6	3816.8	
B	" " Ångström	6874.9	3437.4	3440.10 O.
	" " Fraunhofer	6878.5	3439.2	
C	" " Ditscheiner	6571.1	3285.6	3285.6 Q.
	" " Ångström	6567.7	3283.8	

The above facts would seem to signify that A and B, which belong to the potassium of the visible scale, have their corresponding vibrations, which are twice as fine and rapid in L and O, while C, which is the manifestation of hydrogen, has also its fine corresponding half-length vibrations in Q; in other words grades of potassium and hydrogen twice as fine as those which produce visible effects are represented by the lines in the spectrum called L, O, Q, just as certain tones in music may be repeated in the octave above by means of waves twice as small and frequent as those which form the original tone. The principal difference between the lines A, B, C and L, O, Q is, that in the latter the lines are refracted more widely apart than in the former, which would go to show that the octaves gradually

increase in dimensions as we go upward into the more volatile trans-violet.

2. *Length of Spectrum.* Prof. Stokes has shown that the bright sparks from the poles of iron, aluminum and magnesium, give off light of so high a degree of refrangibility, that distinct bands are situated at a distance beyond the last visible violet ray, ten times as great as the length of the whole visible spectrum from red to violet! These bands cannot, of course, be seen under ordinary circumstances, but when allowed to fall on a fluorescent body, such as paper moistened with (sulphate of) quinine solution, they can easily be rendered visible; or we may photograph them and make them leave their impression on the sensitive film. "In order that these highly refrangible rays may be seen, no glass lenses or prisms must be used, as the rays of the highest refrangibility cannot pass through glass: quartz, on the other hand, permits them to pass; hence all the lenses and prisms must be made of quartz" (Roscoe's Spectrum Analysis, p. 126). Allowing then for the increased length of the upper octaves of color, and considering that the spectrum runs some distance below the red, we may probably conclude that there are eight or ten octaves of color in ordinary sunlight, not quite one of which is visible to the ordinary human eye.

3. *Another harmony between the visible and the invisible parts of the spectrum* was pointed out in the magnesium spectrum by Soret. In examining the trans-violet portion of this spectrum, Mascart found two groups of triple lines, which exactly resembled, in general appearance, the well known group of lines in green which appears in the solar spectrum at *b*. Soret has shown that if the length of the waves in the visible spectrum are represented by unity, the wave lengths of the higher lines would be represented by $\frac{1}{20}$, $\frac{1}{27}$ and $\frac{1}{31}$.

4. Sir John Herschel, Stokes, Hunt, and other eminent scientists have been led by their investigations into the belief of other grades of color besides those which are visible. "We might almost be led to believe," said Herschel, "(from the evident reappearance of redness mingled with blue in the violet rays) in a repetition of the primary tints beyond the Newtonian spectrum."

5. *The Missing Color for the completion of one octave* is immediately above the violet as the beginning of the next color-octave,

or immediately below the red as the beginning of the ordinary visible color-octave, the former being a repetition of the latter, only twice as fine, just as the 8th in the musical scale is the repetition of the 1st with waves twice as small. "Sir John Herschel has shown us that by looking at the spectrum with a cobalt blue glass, we perceive a ray called by him the 'extreme red,' of a *crimson* color below the ordinary red ray of the spectrum. Again, by throwing the spectrum on paper stained yellow by turmeric, a ray of high refrangibility beyond the violet becomes visible, which ray is of a peculiar neutral color and has been called a *gray* or *lavender* ray." (Hunt.) It may be remarked that although the exact color above or below the visible spectrum cannot be perceived by ordinary human vision, or be brought to our perception by any devices of glasses, or saturated paper, or otherwise, from being either too fine or too coarse, yet the above experiments give a very good hint of it. It is said to be "crimson" below the red, but crimson as defined by Webster is "deep red tinged with blue." In other words it retains a little of the blue principle of the violet, as every color must possess some elements of the contiguous color or colors, for according to the proposition of this paragraph, the immediate trans-red portion must be the upper *note* of an invisible scale of colors with the violet principle just beneath it. Again the immediate trans-violet portion is called *lavender*, but lavender itself is a kind of a violet-gray, and this comes from its proximity to the violet, and its comprising more or less of the dark luminelles above the visible spectrum.

6. This invisible color approaches the red far more than the blue in appearance, although it retains some blue cast at the beginning of each chromatic scale, not far from the culminating point of heat, some portion of which it is probable that we may see just below the red. The last syllable of its name, thermel, should be pronounced with sufficient distinctness to distinguish it from the adjective *thermal.*

7. Perhaps the *crowning proof* that there are different grades of colors beyond those usually visible, is that many persons have seen them, especially with the outward eye closed. The eminent scientist, Baron Reichenbach, of Vienna, by means of thousands of experiments with sixty persons, including ladies,

physicians, professors, naturalists, etc., proved beyond all rational doubt the reality of *odic light and color*, while the author has, at times, not only seen these, but a grade still finer and incomparably more beautiful than the colors of the external world. Many others have seen the same, and in the chapters on Chromo-Dynamics and Chromo-Mentalism, I shall attempt to demonstrate the existence and character of these high grade colors in a way which, to reasonable minds, should be convincing. After the first or visible grade of color comes the *odic* light, or 2d grade, and then the third grade, which, being more connected with the mental and soul forces I have named *Psychic*.

8. Two scales of color commencing at the bottom are as follows :

SECOND COLOR SCALE unseen by ordinary VISION. The Odic Lights and Colors consist of finer potencies than those of the visible colors.

The Third grade colors commence with *tertio* thermel, the fourth, with *quarto* thermel, the fifth, with *quinto* thermel, etc.

- Psychic Thermel or Tertio Thermel.
- Odic Dark Violet, or Secundo Dark Violet.
- Odic Violet, or Secundo Violet.
- Odic Violet-Indigo, or Secundo Violet-Indigo
- Odic Indigo, or Secundo Indigo.
- Odic Indigo-Blue, or Secundo Indigo-Blue.
- Odic Blue, or Secundo Blue.
- Odic Blue-Green, or Secundo Blue-Green.
- Odic Yellow-Green, or Secundo Yellow-Green.
- Odic Yellow, or Secundo Yellow.
- Odic Yellow-Orange, or Secundo Yellow-Orange.
- Odic Orange, or Secundo Orange.
- Odic Red-Orange, or Secundo-Red-Orange.
- Odic Red, or Secundo Red.
- Odic Thermel, or Secundo Thermel.

FIRST COLOR SCALE all visible except Thermel.

- Dark Violet.
- Violet.
- Violet-Indigo.
- Indigo.
- Indigo-Blue.
- Blue.
- Blue-Green.
- Yellow-Green.
- Yellow.
- Yellow-Orange.
- Orange.
- Red-Orange.
- Red.
- Thermel, or the invisible heat ray.

9. Thermel is visible as a beautiful color midway between the dark violet and the grade of red just above it, to those who

can see the odic and psychic lights. The lower thermel is probably too coarse for any human eye to take cognizance of. The upper grades of thermel are near the culminating points of heat for their color-scales, but this heat is too fine for ordinary perception, or for measurement by thermometers.

10. If the visible grade of colors comes from the action of the 1st spirillæ of atoms, the Odic or secundo grade probably comes from the 2d spirillæ, and the Psychic or Tertio colors from the 3d spirillæ. Finer colors would necessarily, then, come through a finer atmosphere, unless there are more than three grades of spirillæ in the atoms of the ordinary coarser atmosphere. It is reasonable to suppose that the grades of spirillæ of the same atom are an octave apart, otherwise there would be discordant action as it seems to me. Nature works not only on mathematical but on harmonious principles. But if we are to judge of all things by all other things, as we find we may do in harmony with nature's unity of plan, and knowing as we do, also (see Chap. First, XVI), that all things are on the law of gradation, finer elements dwelling in the coarser, still finer ones in those, and so on, then we must conclude that there are finer atmospheres within the coarser on the same law. Thus we would conclude that there must be a finer atmosphere for the odic lights, another still finer for the psychic lights, etc. For corroboration of this, see Chapter Ninth, III, 2.

XXIV. Color as Related to Taste.

We have already seen (XII), that substances which give burning sensations to the taste, as black pepper, capsicum, etc., are apt to be black and red, and belong generally to the thermal end of the spectrum, although transparent elements being both thermal and electrical, often produce burning and very piercing sensations. *Sweets* belong to both the thermal and electrical colors with a preponderance of the thermal: *acids* to both the thermal and electrical colors, with a preponderance of the electrical, especially the electrical blue of oxygen, although in nearly all acids a small amount of the warm element of hydrogen exists. The *alkalies* have a greater preponderance of thermism than the sweets; the *alcohols* still more being full of the fiery red

principle of hydrogen, while the saline taste has both thermism and electricity nearly balanced. In producing the pleasing effect of sugar ($C_{12}H_{22}O_{11}$) upon the taste, the carbon plays more especially over the surface of the papillæ of the tongue, kindling the nerves; the hydrogen also spreads more directly over the surface of the same, animating the blood, while the oxygen, with its cooling axial force, penetrates more interiorly into the papillæ, and thus combined with the more exterior forces, holds them in a pleasant equipose without allowing any over stimulus. In acids, the oxygen is more abundant and the piercing principle stronger; in alkalies and alcohols the burning principle is intense as in ammonia (NH_3), Caustic Potash (OKH), Strychnine ($C_{21}H_{22}N_{22}O$) and common alcohol (C_2H_6O.) It will be remembered that carbon, hydrogen, potassium, etc., belong to the thermal or red and yellow principles. *A very strong predominance of either thermism or electricity in a substance, is distressing to the taste and very poisonous* in its effects.

XXV. Complexion as related to Sunlight.

1. Dr. Forbes Winslow says: "Black, brown and copper colored skins are observed among those who reside in tropical climates in proportion to the intensity of the solar light, and the degree to which the body is exposed to its influence. The discoloration of the skin is not, however, perceived among those who live in temperate and cold regions. As we approach nearer to the pole the skin assumes a browner cast. This is evidenced among the Laplanders, Esquimaux and Greenlanders. In the Arctic regions, there cannot be said to exist any night. Here a constant light prevails, if not from the sun, yet reflected from the snow and ice, or emitted by the aurora borealis." (Influence of Light.) This darkening or browning effect is thus very properly explained as coming from the amount of light, and yet a little farther along Dr. Winslow says that the "white color of animals inhabiting the polar region is attributable to the absence of intense sunlight." It seems a little inconsistent for the Doctor thus to signify that the people of the Arctic regions are supplied with an almost ceaseless light which, he admits, causes blindness, etc., and yet the animals are whitened by "the ab-

sence of intense sunlight." It would doubtless be a better explanation to say that the animals are made white there by the intense cold and electricity, as we have already seen in this chapter, X, the tendency of cold to whiteness of effect, as in snow, frozen carbonic acid, pale countenances, etc.

2. The sun causes its yellow and brown effect from driving the molecules of carbon into the skin, thus tanning and toughening the cuticle. The cold of the far north prevents the people from becoming as dark as they are in the torrid zones. Dr. Winslow says :—" Intemperate persons, addicted to vinous potations, have a sallow and olive-hued complexion. The dark and dingy color of the pigmy people who live in high northern latitudes, arises principally from the fish and oils of a rancid and often offensive character, upon which they mainly subsist. This kind of diet is believed not only to affect the color of the skin, but to cause a diminution of the stature of this race, in consequence of their blood being difficult of assimilation and defective in nutrition."

3. So far as intemperance darkens the skin, the inhabitants of the temperate zones drink more than they do in the frigid, and have more miasma, also, to make them *bilious* and yellow, and more than that, when they eat pork and fat, especially in warm weather, they have not the amount of keen, electrical oxygen to help them digest this carbon, in the shape of fatty foods, that their northern neighbors have. The carbon, belonging as it does to the thermal substances, needs an affinitive principle of electricity for its proper digestion, for which reason it is more safe to eat it in winter than in summer, and in cold than in warm climates.

XXVI. Summation of Points in Chromo Chemistry.

1. *Spectrum Analysis, which has proved incomparably more exact than any other method of ascertaining the chemical properties of bodies, is founded on the fact that any element, when heated until it becomes incandescent or is converted into luminous vapor, manifests its character in the grade of color which it radiates.*

2. *Instead of there being seven colors in the solar spectrum, there are many thousands of shades and tints of color. Sir David Brewsier*

counted 2000 Fraunhöfer lines, each of which signifies some distinct grade of color, while there is also a large space in the spectrum where no Fraunhöfer lines are visible, over which infinite grades of hues are scattered.

3. *The culminating point of heat in the spectrum is near the thermal; of light, in the yellow; of electricity, in the blue and indigo, although the finest electricity is in the violet. Stokes found the strongest electricities, as signified by means of hydrochloric acid, in the violet indigo. Other substances place it elsewhere, from their especial kinds of chemical affinity.*

4. *Spectrum Analysis, although rich in facts, has not hitherto been crystallized into a science.*

5. *The colors which any substance exhibits in its spectrum, show its repellent or reflective potencies when under chemical combination.*

6. *The ordinary appearance of an element when isolated or cold, shows what color it is repellant of; but when heated or in chemical combination this repulsion greatly changes, becoming more violent, and generally assuming different colors.*

7. *The chemical affinities of a substance may be determined by its repulsions according to the atomic law already explained, Chap. Third, XXXVII, 10.*

8. *Elements which in their cold, isolated character are white, are more electrical in their ordinary condition, but have a predominance of thermism when chemically combined, as in the case of the Alkalies and other white metals.*

9. *Black or dark Elements, though in a thermal condition when uncombined, sometimes have a thermal predominance, sometimes an electrical one in the spectrum, or in chemical combination, according to whether their original grade of black was at the thermal or electrical end of the spectrum, or both, but on the whole have the warm principle more especially.*

10. *Gray and also transparent elements generally have both the thermal and electrical elements largely developed in their spectrum.*

11. *No elements have positive electrical colors in their normal state, but several have positive thermal colors. These under heat or chemical combination tend to assume higher grades of fineness, becoming highly electrical when active.*

12. *The most powerful substances are transparent.*

13. *Transparent Fluids, though abounding in both thermal and electrical potencies, have more frequently a preponderance of electricity.*

14. *Transparent solids, from their thorough polarization, are on the whole unequaled in hardness.*

15. *All substances under free chemical action, tend to repel and stimulate those having the same grade of color with themselves.* Among many applications of this rule we may note how in therapeutics the red-colored substances stimulate the arterial blood, yellow and orange ones the nervous system, including cerebral stimulants, emetics, purgatives, diuretics, etc.

16. *All substances under full chemical action tend to attract, or combine in harmonious union, those substances whose colors have a chemical affinity with their own.* This rule accounts for the blue of the sky and ocean, the green of the leaves, the laws of germination, vision, chemical action in therapeutics, the harmonic contrast of colors in nature, the healing power of sunlight, photographic action, Homeopathic triturations, and many other things.

17. *Not only can it be shown that sunlight is an actual substance capable of being collected, measured and controlled, but the very materials of which each color is composed can be given, and the law of its movement explained.* This is not denying that the undulatory theory of light has important features of truth in it.

18. *The law of Metachromism shows why it is that in binary and some other compounds, the increase of oxygen and other blue-forming elements, develops the red end of the spectrum, while the increase of potassium, hydrogen, and other red or yellow-forming elements, tends to increase the affinitive blue or violet.*

19. *Facts made known by the spectroscope, analogies and the experience of those persons who have a more interior vision developed, show the existence of more refined and beautiful octaves of color beyond those which appeal to the ordinary vision. They show also that the ordinary vision cannot take in quite one complete scale of colors, the heat color below the red in the spectrum, which is termed thermal, being invisible.*

20. *Different colors have relations to taste, such as sweet, sour, alkaline, saline, burning, etc.*

21. *The complexion of people in different zones of the earth is modified by the sunlight.*

CHAPTER SIXTH.

CHROMO-THERAPEUTICS, OR CHROMOPATHY.

I. The Healing Power of Color.

This must be quite evident to the reader by this time, especially as, in the last chapter, we saw the wonderful power of color repulsions and color affinities, and saw also that all things manifest their potencies by means of color. This being true, then, we may construct a more exquisite and exact *Materia Medica*, and erect a standard of medical practice based on principles of almost mathematical precision. Not only may we, by means of the principles already laid down, judge of the medical potencies of the coarser mineral elements, but of the finer potencies of the vegetable world, of water, air, electricity, and magnetism, and the still finer forces of the sunlight. Sunlight constitutes a truly *celestial materia medica* which, according to principle XV of Chap. First, must be more safe, effective and enduring than the cruder elements, in case we know how to control it.

II. Comparative Fineness of Healing Elements.

Minerals are at the bottom of nature's scale of forces, being so crude that the most of their particles are unable to float in the atmosphere, and consequently are held down in the midst of earthy substances. The vegetable world which constitutes the direct food of man, is sifted of the coarser mineral elements by a beautiful and ingenious process, the carbon and some other of the finer elements of the sunlight and atmosphere being received into the plant or vegetable from the sky, while the elements that come from the earth are strained of their coarser ingredients by the spongioles of the root and absorbed only in a

liquid state. It may readily be seen why cereals and fruits, growing, as they do, above ground and drinking in the refined elements of the sunlight so freely, constitute a higher grade of food or food-medicines than the roots, tubers, and bulbs, such as radishes, potatoes, onions, etc., which grow under ground. Water owes its healing power, 1st, to its cleansing character, and 2dly to its electricity, combined also with a goodly amount of thermism. The electro-magnetic machine also presents similar grades of fine elements, inasmuch as, like water, it combines galvano, magneto and other grades of electricity. Pure air furnishes a somewhat more ethereal combination of elements than water, as it includes those which are sufficiently volatile to float, and presents fine ethers, which during the day-time are so constantly under the action of sunlight. But the finest potency of all, of which we can avail ourselves in the external world, comes from the sunlight, the only known element which transcends it in fineness, being the psycho-magnetic radiation from highly organized human beings. By understanding the etherio-atomic law we see at once how all things must incessantly radiate their peculiar essences and ethers, all ethers partaking more or less of the substances through which they pass, the finest substances having the finest emanations.

III. The Healing Power of Red.

1. According to principles XIX and XX in the last chapter, red must stimulate and increase the action of the warm red principle in the human system, as for instance, the *arterial blood*, and also act as the harmonizing affinitive element of the cold blue principle, which causes blueness of veins, paleness of countenance, etc. Examples have already been given, but a few examples quoted a little more minutely in the exact words of the U. S. Dispensatory and other recognized authorities, will help the better to establish the principles of not only the red but other colors, so far as drugs are concerned; having established which, we may be sure from the unity that reigns throughout nature, that the same principle in sunlight and every where else must produce similar results, the difference being that fine elements like the sunlight are more penetrating, safe, and enduring than coarse drugs.

2. The *Balsam of Peru* (Balsamum Peruvianum) "is of a dark reddish brown color, a warm bitterish taste, leaving when swallowed a burning or prickling sensation in the throat," "is a warm stimulating tonic and expectorant."

3. *Cayenne Pepper* (Capsicum) Flowers white, "fruit smooth and shining, of a bright scarlet, orange or sometimes yellow color." "Powdered capsicum is usually of a more or less bright red color;" "is a powerful stimulant, producing a sense of heat in the stomach and general glow over the body;" "an arterial stimulant and rubefacient."

4. *Cloves* (Caryophyllus) "are externally deep brown, internally reddish, their taste hot"—"among the most stimulant of aromatics."

5. *Bromine.* "A red liquid," "caustic and irritant,"—"when diluted, tonic and diuretic." (Waring.)

6. *Iron. Ferric Oxide* (Fe_2O_3) "is of a reddish color and forms salts which, for the most part, have a reddish color." *Ferrous Trioxide* (FeO_3) "wine red color." "The preparations of iron are powerfully tonic, raising the pulse, promoting the secretions, and increasing the coloring matter of blood."

7. *Red Cedar* (Juniperus Virginiana), "stimulant, emmenagogue and diuretic."

8. *Musk.* "Powder, reddish brown, is a stimulant and antispasmodic, increasing the vigor of the circulation."

9. *Ammonium Carbonate* ($N_4H_{16}C_3O_8$). Powerful in the red principle of hydrogen. "An arterial stimulant."

10. *Alcohol* (C_2H_6O). Red predominates strongly from its Hydrogen. "A diffusible stimulant of heart and arteries—exciting to the nervous and vascular system, succeeded by equal depression."

11. The power of *oxygen* to develope the red principle of the blood and thus by reaction to harmonize and animate the system which has become too cold and sluggish, under a predominance of the bluish venous blood, is well known. The power of *red glass* and a red chamber to excite, cheer and cure the cold morbid condition of two despondent lunatics, as proved by the experiments of Dr. Ponza, has already been spoken of in Chap. Fifth XX, 20.

IV. Healing Power of Red Light.

Red light, like red drugs, is the warming element of sunlight, with an especially rousing effect upon the blood and to some extent upon the nerves, especially as strained through some grades of red glass which admit not only of the red but the yellow rays, and thus prove valuable in paralysis and other dormant and chronic conditions. The following facts are quoted from Dr. S. Pancoast's new work, entitled *Blue and Red Light:*—

1st Case.—Paraplegia (Paralysis of both Legs).

"Master F., aged 8 years, had a tedious convalescence from a severe attack of diphtheria, which was suddenly interrupted by a very severe attack of paraplegia; the paralysis was almost complete; he could not walk and could stand only when supported by a table or chair. We had him arrayed entirely in white and placed in strong *red* baths from one to two hours at a time; soon after being placed in the red light he would fall asleep, and a profuse perspiration burst forth, saturating his underclothing; in three weeks he was walking firmly, and in two months was perfectly well. More than two years have since elapsed and he has continued in perfect health."

2d Case.—Consumption in the Third Stage.

"Mrs. H., aged 35 years. This was a case of *consumption in the third stage, with both lungs involved,* the left hepatized with mucus râle through the upper third, and crepitation in the apex of the right lung; sputa copious, amounting to half a pint in twenty four-hours; her expectoration was a yellowish, ropy and frothy mucus and pus, a portion of which sank in water; she had severe night-sweats, and chills or creeps regularly at 11 o'clock, A.M., followed by fever with flushed cheeks." Dr. Pancoast proceeds to show that her parents and most of the family had died with consumption. He continues:—"I placed Mrs. H. under red baths regulated by the effects produced. In two weeks improvement began to manifest itself in all her symptoms; in another week the mucus râle became a sub-mucus, then successively a crepitant and a bronchial; soon respiration was resumed through the entire left lung, and the crepitation at the

apex of the right lung disappeared; expectoration improved and the cough became less frequent and less distressing; with the improvement in these symptoms the chills and fever and the dyspnœa disappeared and her strength rapidly increased; in two months and a half, the only remaining trouble was a slight hacking cough arising from an irritated throat." Dr. Pancoast proceeds to state that she remained well between one and two years, and then, from assuming extra duties, caught a severe cold which developed into pneumonia and finally led to her death. He says that "in an active and extensive practice covering more than 30 years, we have never known or heard of a case of consumption at so advanced a stage successfully treated. Her recovery was entire."

If in the above case a deep blue glass had been used for her head, and beneath this some red, and then yellow, and then red for the limbs, it would doubtless have been a still more potent combination.

3d Case.—Complete Physical Exhaustion.

"Mr. R., 45 years of age, an overtaxed and prematurely worn out man of business became involved in financial troubles, * * mind and body were continuously on the rack, he could neither eat nor sleep normally, and at last complete physical exhaustion and nervous prostration naturally came upon him, for nature could endure no more. The first warning was severe pains in the back of the head, soon followed by shortness of breath, flutterings of heart, compressible pulse, loss of appetite, constipation and phospatic urine. * * We determined to try the red light treatment, especially as his prostration was unattended by any indication of morbid irritability, and in all our experience as a physician, we have never witnessed more remarkable beneficial results than were at once produced by the red ray in this case. The very first bath had the most encouraging effect: it acted as a tonic both upon mind and body, dispelled his gloomy apprehensions and gave vigor to his physical functions. Commencing with small doses, we gradually increased them until assured that we had reached the most effective dose in proportion of red to plain panes and in length of bath. Mr. R. rapidly improved, notwithstanding his continued attention to

business. From the first he slept more refreshingly, ate with better relish, his bowels became regular, and the secretions of his kidneys recovered the healthy appearance. Three weeks treatment sufficed, and there have been no signs of relapse."

4th Case.—Uterine and Nervous Prostration.

"Mrs. S., 45 years of age, had naturally a frail constitution, was from youth weak and delicate, with a tendency to nervous prostration; easily despondent, and ready to give up when ill. Her natural weakness had resulted in and been augmented by uterine difficulties which had continued for ten years, and had at last broken down her entire system, when she called on us for professional advice. Her condition was such that the slightest exertion completely overcame her and sent her to bed for days at a time; the influence of 'the change of life,' had brought on the crisis in an illness that kept her bedfast, which was directly attributed to a brief visit to the Centennial Exhibition; but this last was but a feather in the balance—the attack was impending and the excitement of the visit only hastened it. We applied the blue and red light treatment, alternating not at equal intervals, but according to variations in her symptoms. Her recovery was rapid and permanent—a whole day at the Centennial some time afterwards did not over fatigue her. She has enjoyed better health uniformly since the treatment than ever before."

V. When the Red is Injurious.

1. Red is injurious, of course, when there is already too much of the red, or inflammatory condition of the system, such as the predominance of red hair, very rubicund countenance, or feverish and excitable condition generally.

Iron, the preparations of which abound in the red, is "contra-indicated in inflammatory diseases, producing, when injudiciously employed, heat, thirst, head-ache, difficulty of breathing and other symptoms of an excited circulation;" "contra-indicated in the sanguine temperament generally."

2. The same is true of the other red elements, or of elements in which red abounds in the spectrum, but the principle is too obvious to need further examples. The exciting effect of red

objects on various animals is also well known. That red light has exactly the same exciting effect is well known. I quote the following from a letter of a thoughtful observer, Edwin M. Hale, M. D., to the Chicago Tribune :—

3. "In one of the French Insane Asylums, not only the blue ray but others were tried, and the effect was very interesting. The red ray caused results which confirmed the popular belief in its exciting, maddening influence. When violent and maniacal patients were placed in rooms where the red ray predominated, they became worse. All the violent symptoms were aggravated. If these patients were removed to a room where the blue ray predominated, they become calm and quiet. It is related that one patient, a woman, whose delirium was greatly aggravated by the red ray, immediately said on going into the blue room—'how soothing that is,' and shortly after, when left alone, fell asleep."

4. *Thermel* must naturally produce an effect somewhat similar to that of red, so far as its heating qualities are concerned, but being invisible cannot, of course, affect one through the optic nerve.

5. Dr. Pancoast speaking of the red light says that "if employed to excess, as to amount or time, the red light over-excites the nervous system and may produce dangerous fevers or other disorders that may prove as troublesome as the evil we are seeking to correct. We seldom employ red light to the exclusion of the other rays, and it should never be so employed, except in extreme cases, when prompt action is the first consideration."

The danger of the above "exclusive red light," which Dr. Pancoast deems so great as to require "a skilful physician," may be averted by using the red glass only a few minutes at a time at first, taking the precaution when the system becomes too hot, to put blue glass in its place, or a wet bandage over the head. For general cases, however, it would be better to have blue glass over the head and red and clear glass over the rest of the body in conditions of lethargy. A better arrangement still is the instrument devised by the author called the CHROMOLUME, in which both physiological and chemical laws are complied with in the harmonic arrangement of glass. See explanation in XXIII and XXIV of this chapter.

VI. The Healing Power of Yellow and Orange.

We have seen in the last chapter (XIX, 3) the law by which the *nerves* become stimulated, more especially by the yellow color, and to some extent by the orange and even the red, these principles being included in the substance of the nerves themselves. We have seen that the more violent nerve stimuli include something of the red or orange as well as the yellow, that drugs taken internally, when sufficiently active and exciting and working, no doubt, to some extent upon the vascular as well as the nervous tissues of the stomach, cause that quick repulsive action which is termed EMETIC; that those drugs whose yellow principle works somewhat more slowly, do not exert their expansive and repulsive action until they reach the bowels and thus constitute LAXATIVES, or when sufficiently active, PURGATIVES; that certain drugs which have an affinity for the liver and bile, causing them to act, are called CHOLAGOGUES; that those which stimulate the kidneys are called DIURETICS; those which stimulate the uterus, from some special affinity they may have for that organ, are called EMMENAGOGUES; those which stimulate the nerves of the skin and to some extent the vascular glands in a way to cause perspiration are called DIAPHORETICS; those which stimulate the nerves of the skin and call the blood outward until the surface becomes reddened are called RUBEFACIENTS. In all cases yellow is the central principle of nerve stimulus as well as the exciting principle of the brain which is the fountain head of the nerves, although, as we have seen, the more violent elements of stimulus approach the red, especially where vascular action is called forth. Those elements which act more directly to excite the brain, are called CEREBRAL STIMULANTS. I will give a few examples of the different drugs and foods which belong to the various departments of nerve action :—

VII. Emetics, Yellow with some Red and Orange.

1. *Indian Hemp* (Apocynum Cannabinum). The root is of "a yellowish brown while young, but dark chesnut (red brown) when old, with a nauseous acrid taste." "The internal ligneous part is yellowish white." "Powerfully emetic and cathartic, sometimes diuretic."

2. *Lobelina.* "The active principle of lobelia is a yellowish liquid." "Lobelia is emetic, occasionally cathartic, diaphoretic," etc.

3. *Tartar Emetic* ($KSbC_4H_4O_7$, H_2O), "a white crystalline salt," with the yellow, orange and red all strongly developed in the spectra of its elements. "According to the dose it acts variously as a diaphoretic, diuretic, expectorant, purgative and emetic."

4. *Bloodroot* (sanguinaria). "The whole plant is pervaded by an orange colored sap. The color of the powder is brownish red." The leaf "is yellowish green on the upper surface, paler or glaucous on the under, and strongly marked, by orange-colored veins." "Sanguinaria is an acrid emetic, with stimulant and narcotic powers."

5. The fact that emetics deal so much in the red as well as in the yellow principle shows that they act more or less upon the blood and muscular tissues as well as the nerves. "The action of an emetic is directly or indirectly upon the nerve centres that supply these muscles. * * All emetics acting through the blood produce more or less depression." (Hartshorne). Emetics act principally upon the pneumogastric nerve.

VIII. Laxatives and Purgatives—Yellow the principal color, or red in Drastic Purgatives.

1. *Podophyllum* or *May Apple.* "Yellowish green petioles." "The fruit is lemon yellow, diversified by brownish spots." "The powder is light yellowish gray." "An active and certain cathartic. In some cases it has given rise to nausea and vomiting." "A hydragogue and cholagogue." The office of a cholagogue is to cause a flow of bile, which is of itself a yellow or yellow green fluid that has a laxative effect as it passes into the duodenum and lower bowels.

2. *Senna,* (Cassia Marilandica). "Flowers beautiful golden yellow; the calyx is composed of five oval yellow leaves; the stamens are ten, with yellow filaments and brown anthers." "An efficient and safe cathartic."

3. *Colocynth* (colocynthis). "Flowers are yellow." "Fruit yellow when ripe." "Contains a white spongy medullary matter." "A powerful hydragogue cathartic."

4. *Copaiba.* "A transparent liquid of a pale yellow color." It is "stimulant, diuretic, laxative."

5. *Gluten, phosphate of lime,* etc., which constitute the hard yellow portion of grains near the external portion, are somewhat laxative.

6. *Figs* (Ficus). "The best are yellowish or brownish." "Figs are nutritious, laxative and demulcent."

7. *Magnesia* (MgO). The yellow-green principle strongest in the spectrum of magnesium. "Antacid and laxative."

8. *Magnesium Carbonate* ($MgCO_3$). The yellow strong in both carbon and magnesium. "Laxative."

9. *Castor Oil* (Oleum Ricini). "Yellowish." "A mild cathartic."

10. *Olive Oil* (Oleum Olivæ). "Pale yellow or greenish yellow." "Nutritious and mildly laxative, given in case of irritable intestines."

11. *Sulphur* is "pale yellow * * laxative, diaphoretic," etc.

12. *Magnesium Sulphate* (Epsom salt, $MgSO_4$), has the strong yellow principle of magnesium and sulphur, but is toned down by the cool blue of oxygen, so it is called "a mild and safe cathartic," a "refrigerant," etc.

13. *Eggs* (Ovum). "The yolk in its raw state is thought to be laxative."

14. *Prunes* (Prunum). Yellowish brown or orange brown. "Laxative and nourishing."

15. *Peaches* have a yellowish pulp. Gently laxative.

16. *Cape Aloes* (Aloe). "Powder greenish yellow." "Cathartic."

17. Many more similar examples could be given, but these are quite sufficient to establish the potency of yellow as connected with the nerves of the bowels. I will quote the following, however, to show that when we appeal more to the red principle with drugs we reach the coarser elements of blood and thus produce a more severe and drastic effect than when dealing more exclusively with the finer elements of the nerves :—

18. *Gamboge* when broken "is of a uniform reddish orange, which becomes a beautiful bright yellow." "Gamboge is a powerful drastic hydragogue cathartic, very apt to produce nausea and vomiting, when given in the full dose."

19. *Black Hellebore* (Helleborus niger). "The flower stem is reddish toward the base," has "rose like flowers." The petals are of a white or pale rose color with occasionally a greenish tinge." The root is "externally, black or deep brown, internally white or yellowish white, producing on the tongue a burning and benumbing expression, like that which results from taking hot liquids into the mouth." "Black Hellebore is a drastic hydragogue cathartic possessed also of emmenagogue powers. The fresh root applied to the skin produces inflammation and even vesication." A good example of the burning qualities of black and red.

20. *Croton Oil* (Oleum Tiglii), "varies from a pale yellow to a dark reddish brown. Its taste is hot and acrid—it is a powerful hydragogue cathartic, in large doses apt to excite vomiting and severe pain."

21. *Senna* (Cassia acutifolia, etc.). "The leaflets are yellowish green color, the flowers are yellow, the fruit grayish brown." "The infusion is of a deep reddish brown color. When exposed to the air a short time, it deposits a yellowish insoluble precipitate. It is a prompt and safe purgative. An objection sometimes urged against it is that it is apt to produce severe griping pain."

22. *Rhubarb* (Rheum). "Good rhubarb is yellow, with a slight reddish brown tinge;"—"unites a cathartic with an astringent power, the latter of which does not interfere with the former, as the purgative effect precedes the astringent; * * appears to affect the muscular fibres more than the secretory vessels. It sometimes occasions griping pains in the bowels."

23. Why it is that a substance like *potassium tartrate*, and other saline substances may have the rubific element of potassium, and yet be but a "mild refrigerant cathartic," is easily explained by noticing the amount of oxygen ($C_4H_4K_2O_6$) which moderates and cools the thermal and expansive qualities of the other substances, and acts somewhat as it does in acids.

IX. Healing Power of Yellow Light aided by Some Red and Orange:—Laxative, Animating, etc.

1st Case.—Costiveness.

In a case of costiveness at my office, during the month of June, I let the sunlight pass through some yellow-orange glass of a hue which is usually termed yellow, and over which I had placed a lens to concentrate the rays the better at certain points. I gradually moved the focus of the yellow light over the whole bowels but especially over the descending color on the left lower side. Commencing at 2 P.M., I continued the process for 10 minutes. The perspiration was started over the whole body, although the thermometer stood at only 70° F. In 5 minutes after receiving the light, the bowels commenced the rattling motion similar to what is experienced with physic, and in 18 minutes a gentle passage was caused, and that wholly without pain. Some persons would require 2 or 3 times as long an application as the above. I have caused the same results with the chromo-disc to be described hereafter. Any deep yellow glass would act in the same way, but the yellow-orange hollow lens which, the author has devised, is more prompt and effective than any other instrument, and charges the water within for internal use while it is being used externally.

2d Case.—Bronchial Difficulty.

In a case of Chronic bronchial irritation, I used the chromo-disc over the breast, straining a hot sunlight thus concentrated by reflection, through yellow glass. In less than a minute I was able to rubricate the skin. I used it about 15 or 20 minutes each day for several days. The patient felt uncommonly animated and clear in his mental perceptions, and his bronchial difficulties gradually decreased. The same result would, of course, be produced by means of yellow glass without the chromo-disc, by taking a longer time, or even by hot sunlight, by taking a still longer time. The Chromo Lens to be hereafter described is entirely unequalled in the rapidity and power of its action.

3d Case.—Costiveness cured by Charged Water, etc.

Knowing as I did the power of the yellow and orange light to act upon the system directly, I concluded at once that it must have the power of so charging other substances that they would act upon the system in the same way, and as ordinary lamp light and gas light abound in the yellow-orange principle of carbon, etc., I was confident that they might be used with yellow glass to good advantage.

Having been costive for a few days I held a small half-ounce amber colored vial of water close to a kerosene lamp for 7 minutes, before retiring, and then drank it. In the morning I had two gentle passages without any pain, and for weeks experienced no return of costiveness. This is a good example to show the enduring character of the cures wrought by the finer elements.

4th Case.—Animating and Laxative Effect of Do.

The following letter from Mr. E. Norris, Artist, 59 Columbia st., Albany, N. Y., will explain itself :—

"Dr. Babbitt: My Dear Sir :—I have tried the novel experiment of the yellow light and have been astonished at the results. I have found water charged with the sun's rays through yellow glass to be an absolute and to me unfailing cathartic; in small doses a gentle laxative, and in all cases exhilarative to the spirits. What its qualities are beyond these effects I do not know, but this much seems certain and it is marvelous. To me it is a great blessing, and I shall remember you with kind feelings. I am quite well, made, and kept so, by the yellow light."

5th Case.—Do.

A lady of East Tennessee, who had suffered with constipation and feeble health for many years, was advised to drink water charged in yellow bottles. She wrote me that she was drinking water charged in yellow wine bottles, and asked me to send her bottles of the right shade of color, remarking as follows: "My bowels have been acted upon now five successive days. I am so delighted that I can scarcely wait the intervening time before receiving yours." I had not then got my yellow chromo lenses ready, and so had to recommend the poor substitute of yellow bottles.

6th Case.—Costiveness and Hemorrhoids.

Mrs. C. A. von Cort, of New York, author of "Household Treasure and Medical Adviser," and a lady of considerable medical experience, received from me a bottle of sugar of milk which I had charged with yellow-orange light, and the usual dose of which was an amount as large as one to three peas. Concerning its effects she wrote me the following letter, speaking of her experience in giving to Mrs. VanKeuren, of Morrisania, and enclosing a note from the latter :—

"Mrs. VanKeuren has suffered with hemorrhoids so severely that all ordinary purgatives which her physicians have given her, cause intense pain, and prove very prostrating. Your medicine charged with the yellow-light is elegant, and works gently and admirably." C. A. von Cort.

The following is Mrs. Van Keuren's letter :—

"Mrs. von Cort :—Please tell the doctor that the medicine you gave me has had the desired effect. The first needed a little assistance, the last one after 24 hours relieved me without help almost free from pain. I feel easier to-night than I have been for months."

The first dose was doubtless too small, on account of her great costiveness. In severe cases it would be well to take two to four teaspoonfuls of charged water before each meal, until the bowels move, or even every hour in an emergency. The water can be charged somewhat in a few minutes of bright sunlight, but I allow my lenses to lie out of doors on the window ledge where the light can strike them constantly, meantime putting in fresh water every two or three days in hot weather to keep it pure. I have tested the power of water charged in these yellow-orange lenses in a great number of cases, and uniformly with the same effect, excepting with two or three persons whose bowels were already in a positive and active condition. With these no change was discovered. I also had a patient whose bowels were so very much constricted as to resist all ordinary medicine, and which resisted a single dose or two of the charged yellow water, but I feel confident that if the water had been taken hourly the proper result would have been accomplished during the day.

I use deep blue lenses for water to check diarrhœa, or inflam-

mation, or sleeplessness, as will be seen hereafter. I have also a few purple lenses in which I charge water for indigestion, although I may not be able to supply the public yet, excepting a few physicians, to whom it is highly important, as their manufacture for a small number is troublesome.

The above examples, and all of my experience with the yellow-charged water, or blue-charged water, go to prove the *gentle*, safe and *enduring* effect of these refined elements, and their influence on the mind, in harmony with principle XV of Chapter First, and the reason of this deep and radical influence is that they deal directly with the nerve-forces which lie at the seat of power, instead of the blood, or muscles, or other subsidiary functions, and that, too, without clogging the system with coarse and poisonous elements, such as is too commonly done with drugs.

X. Diuretics, Diaphoretics, Emmenagogues, etc.:—

YELLOW AIDED BY A CONSIDERABLE RED.

Several of these have already been given. A few more will suffice to settle the principle.

1. *Dandelion* (taraxacum). "It has a golden yellow flower. The fresh, full grown root is of a light brown color externally, whitish within, having a yellowish ligneous cord running through its center. Taraxacum is slightly tonic, diuretic and aperient; and it is thought to have a specific action upon the liver."

2. *Pure Carbonate of Potassium* (CO_3K_2. $2\times H_2O$). Red and yellow principle modified by the blue in the spectrum. "Antacid, alkaline and diuretic."

3. *Potassium Nitrate* (Salt Petre, NO_3K or NO_2 (OK). The red, yellow and blue principles all strong in the spectrum. "Refrigerant diaphoretic."

4. *Sassafras Oil* (Oleum Sassafras). "Yellowish, becoming reddish by age." "A mild diaphoretic."

5. *Seneka* (Senega). "Externally brownish, internally yellowish." "An active, stimulating expectorant, acting in overdoses like squill, as a harsh emetic, and also having some tendency towards the kidneys.

6. *Buchu* (Leaves of Barosma). "Brownish yellow," etc.

"Gently stimulant, with a particular tendency to the urinary organs, producing diuresis, and like all similar medicines, exciting diaphoresis when circumstances favor this mode of action."

7. *Oil of Savine* (Oleum Sabinæ $C_{10}H_8$). "Colorless or yellow," has also the red principle of hydrogen, "is stimulant, emmenagogue and actively rubefacient."

8. *Mustard* (Sinapis). "Black mustard seeds are of a deep brown color, slightly rugose on the surface, and internally yellow. White mustard seeds are of a yellowish color and less pungent taste." "Mustard seeds act as a gentle laxative." Its powder made into a poultice, or sinapism, "is an excellent rubefacient."

XI. Cerebral Stimulants:—Yellow with some Red and Orange.

1. *Opium* is "reddish brown or deep fawn—when pulverized, a yellow-brown powder. Opium is a stimulant narcotic; it increases the force, fulness and frequency of the pulse, animates the spirits and gives new energy to the intellectual faculties. Its operation is directed with peculiar force to the brain, the functions of which it excites even to intoxication or delirium." After this comes the reaction in the form of sleep, then "nausea, headache, tremors—all the secretions, with the exception of that from the skin, are either suspended or diminished; the peristaltic action of the bowels is lessened," etc.

2. *Saffron* (Crocus), "has a rich deep orange color." "In small doses it exhilarates the spirits and produces sleep; in large doses gives rise to headache, intoxication, delirium, etc.

3. *Valerian* (Valeriana). "The powder is yellowish gray. It is gently stimulant with an especial direction to the nervous system. In large doses it produces a sense of heaviness, pain in the head," etc.

4. *Ether is* a colorless fluid, but strong in the yellow principle of carbon and the red principle of hydrogen ($C_4H_{10}O$). "Ether is a powerful diffusible stimulant, possessed also of expectorant, antispasmodic and narcotic properties." "Its effects are increased arterial action with delirium and diminished sensibility, followed by unconsciousness," etc.

5. *Water, charged with yellow and some red light* through a yellow chromo lens, is stimulating to the brain and nerves,

as signified in IX of this chapter, and leaves no bad after effects, as is the case with drugs.

XII. Tonics:—Yellow and Red Predominant.

1. Tonics are substances which gently and persistently stimulate and invigorate the human system, especially the nutritive and blood-making functions. I have already given several of them in the preceding matter and will mention but few here. Some of the best tonics have a fair share of the electrical colors also. Vegetable tonics are generally bitter and appetizing. Quinine and Iron are called the most important tonics.

2. *Quassia*, yellowish, flowers sometimes red. "Highly tonic."

3. *Gold thread* (Coptis). Roots of a golden color. "Tonic bitter."

4. *Gentian* (Gentiana), "yellowish powder." "Tonic."

5. *Peruvian Bark* (Cinchona). Pale, yellow and red varieties. "Excites warmth in the epigastrium," etc. "Nausea and vomiting," also "purging" sometimes caused. "Frequency of the pulse is increased." Its action upon the nervous system is often evinced by a sense of tension, or fulness, or slight pain in the head, singing in the ears and partial deafness." Its most important extract is *Quinine* or *Quinia*, whose component parts are as follows, $NC_{20}H_{12}O_2$.

6. *Iron*, already described, see III of this chapter.

7. *Myrrh* (Myrrha), "reddish yellow or reddish brown." "Tonic and stimulating, with a tendency to the lungs and uterus."

8. *Ginger* (Zingiber), "yellowish brown." "A powerful stimulant."

9. *Black Pepper* (Piper Nigrum). "Piperin the active principle of pepper is in transparent crystals—as ordinarily procured it is yellow." Formula of piperin, according to Wertheim, $N_2C_{70}H_{37}O_{10}$. "Black pepper is a warm, carminative stimulant, capable of producing general arterial excitement."

XIII. When Yellow is Injurious.

1. Yellow is injurious and over exciting to a system which

has the nervous condition already very active and perhaps irritable. Dormant, paralytic, costive, cold, chronic and stupid conditions, inert tumors, etc., are greatly relieved by the yellow, aided by the red principle, but in fevers, acute inflammations, delirium, diarrhœa, neuralgia, palpitation of the heart, and over excitement of any kind, it is evident enough that these colors are contra-indicated. I will quote briefly again from Dr. Hale :—

2. "Green is a quieting color, if not too green. A dark green is like a dark blue, it seems to lose its calmative power. Nor must the green have a suggestion of yellow in it, for yellow, like red, irritates the nerves of the insane. I have had patients who begged to have the yellow shades removed from the windows, it 'irritated them so.' In the asylum to which I have alluded, there were a number of patients afflicted with melancholy. Some of them were placed in the blue rooms, others in the green. In both instances their malady seemed aggravated, or at least not benefited. Those placed in the yellow rooms complained that it made them feel badly. They become morose. All were benefited, however, by being placed in the red room, or in rooms lighted by ultra violet rays. The extreme violet rays, which some would call purple, are very stimulating to the nervous system. Children become exceedingly nervous from the bright sunlight, containing an excess of red and yellow rays. When ill from teething, from fever, and especially when the brain is affected, they instinctively turn from these rays, and seem to be soothed by a pale blue, or gray light."

3. These remarks show a thoughtful study of the subject on the part of Dr. Hale, but should be modified slightly to prevent readers from being misled. Dark green and dark blue are spoken of as not being *calmative* in their nature. The doctor is evidently speaking of those persons who are melancholy and are already overstocked with the blue venous blood. To such ones these colors would simply be adding sombreness to sombreness, and of course they would not calm them. All the electrical colors must be more or less calmative to an excited human system as will be shown hereafter. All the circumstances with reference to the inmates of the asylum, show that their melancholy was due to a considerable extent to an excess of venous blood, from their repugnance to blue, and to an excess of nervous sensibility from

their being injured by the yellow. Whenever they were under the chemical affinity of the yellow, namely the violet, they were benefited, not because the ultra violet is stimulating to the nerves, as the doctor supposes, but just the contrary as already shown (Chap. Fifth, XX, 18). Their nerves were already over excitable. A red purple is stimulating, especially to the blood. The stimulus which they most needed was in the red to offset the excess of blue in the veins, and this is the reason that the red was so useful to them. My own experience has shown me that persons with the erysipelas or an excitable nervous condition, cannot endure much of the strong sunlight without harm. The red, orange and yellow rays prove too exciting for them. A lady patient who inherited something of an erysipelatous condition, and was also neuralgic and otherwise excitable until she had spells of insanity, always became worse after taking baths of white light and found even blue and white light too exciting for her. Blue glass was far more soothing, but the glass which she used being mazarine, admitted so many of the other more exciting rays, that she could not use that very long at a time without feeling their exciting effect. I advised two thicknesses of the blue and the exclusion of all other rays.

4. One great reason why yellow rules in the most violent of *poisons*, such as *Prussic acid* and *strychnine*, is because of the prominence of the yellow principle as a stimulus of the nerves combined with the red principle as a stimulus of the blood. Thus *strychnine*, according to Liebig, is composed as follows: $N_2C_{44}H_{23}O_4$, which shows a decided predominance of the yellow principle in the carbon, much power of the red in the hydrogen, and not enough of the electrical oxygen to balance the irritating and fiery action of these thermal elements. "Next to Prussic acid, strichnia is perhaps the most violent poison in the catalogue of medicines." Prussic acid is constituted as follows:— CNH, which gives great power of the yellow principle in carbon, and even in nitrogen, predominating red in the hydrogen and no decided electrical element to balance all this thermism, although the nitrogen may be considered slightly more electrical than it is thermal when in combination. "Strichnine acts especially as an excitor of the motor filaments of the spiral cord, causing tonic muscular contractions." "Hydrocyanic (prussic) acid, in poison-

ous doses, acts conjointly on the cerebrum and spinal cord. All the animals I have seen killed by this agent, utter a scream, lose their consciousness and are convulsed. These are the symptoms of epilepsy. * * * The phenomena of epilepsy are eminently congestive. While the cerebral functions are for the time annihilated, the spinal ones are violently excited." (Bennett.) When prussic acid is taken in large amounts, the patient may fall almost as if struck by lightning."

5. The yellow principle then being so powerful in its action on the nerves, we may easily understand why large doses of yellow drugs are said to cause convulsions, delirium, vomiting, drastic purging, etc. Even so mild a substance as *coffee* with its yellow brown principle is said to be "contra-indicated in acute inflammatory affections," causing "nervous excitement" and a "disposition to wakefulness." Of *dandelion* it is said that "an irritable condition of the stomach and bowels, and the existence of acute inflammation contra-indicate its employment." Other even more active drugs with yellow, and especially with yellow and orange, or yellow and red potencies predominant, such as mercury, jalap, opium, alcohol, etc., must be still more disastrous to a sensitive nervous or sanguine system, especially when taken in large amounts. Coffee, though yellowish brown and laxative in some of its elements, has an astringent principle in its tannin. Those who wish to escape some of the worst effects of coffee, should not let it steep more than five to ten minutes, when the coffee grounds should be removed from the liquid to prevent the tannin from escaping into it. Under such circumstances I have found coffee laxative than otherwise.

XIV. Healing Power of Blue and Violet.

NERVINE, ASTRINGENT, REFRIGERENT, FEBRIFUGE AND SEDATIVE.

1. We come now to the cold, electrical and contracting potencies, which are very fine and penetrating, and also very soothing to all systems in which inflammatory and nervous conditions predominate. As we have seen in the last chapter, substances combine in a harmonizing union with those substances whose colors form a chemical affinity with their own and thus keep up that law of equilibrium which is the safety of all things. This

law having been so abundantly explained, it is obvious beyond all guess work, that if the red arterial blood should become over active and inflammatory, blue light or some other blue substance must be the balancing and harmonizing principle, while again, if the yellow and to some extent the red and orange principle of the nerves should become unduly excited, the violet and also the blue and indigo would be the soothing principles to have applied. This applies to the nerves of the cranium, stomach, bowels, and kidneys, as well as elsewhere, in which the heating and expansive action of these thermal principles may beget the condition of delirium, emesis, diarrhœa, diuresis, etc., that can be assuaged only by the cooling and contracting influences of substances possessing the electrical colors. Can this law, which thus stands out clearly and simply like a mathematical demonstration, be shown to have a basis in actual practice in harmony with the experience of the medical world for ages back? The following are a few of the many facts that settle these principles and assist in crystallizing them into a chromo-therapeutical science. In considering them, the reader, who has become familiar with the working of atoms (Chap. Third), will readily understand that the electrical blue and violet forming atoms of substances, being the interior ones which are encased more or less by thermal atoms, must have their colors in part or wholly concealed at times by the encasing atoms, or at other times subject to the law of metachromism which reverses the usual order of things especially in binary compounds (See Chap. Fifth, XX, 19, and XXII, 4, which the reader should be familiar with before proceeding farther). The law as a whole stands out in prominent light :—

2. *Aconite* (Aconitum napellus). "Flowers dark violet blue." "A powerful nervous sedative and anodyne." "Applicable to cerebral inflammations."

3. *Belladonna*, or Deadly night-shade, "has purplish stems," leaves "ultimately of a deep purple color, with violet colored juice." "The root is reddish brown, internally whitish." "Has sometimes been mistaken for a parsnip." "Soothes irritation and pain particularly in nervous maladies;" "is a powerful narcotic, possessing also diaphoretic and diuretic qualities," "causes dilatation of the pupil," "a powerful poison." Belladonna, from its large amount of yellow and red principle in its carbon and

hydrogen, is stimulating, and from its electrical principle is soothing, thus combining both styles of force.

4. *Foxglove* (Digitalis purpurea). "Beautiful purple flowers;" "Powder of a fine deep green," "a red coloring principle, chlorophyl, albumen, starch, etc. Digitalis is narcotic, sedative and diuretic." In large doses a strong poison, leading to "convulsions, vomiting," etc.

5. *Ergot* (Ergota), "is in solid grains of violet brown color externally, yellowish white or violet white within." "Ergot has been much used for promoting contraction of the uterus." Dr. Müller found it to check the bleeding from large divided arteries (applied externally), and Dr. Wright states that "either in powder or infusion it has a prompt effect in arresting hemorrhage."

6. *Cranesbill* (Geranium). "Large purple, often spotted flowers." "Our best native astringent."

7. *Logwood* (Hæmatoxylon). "The flowers have a brownish purple calyx, and lemon yellow petals." "Of itself it is not a coloring substance, but affords beautiful red, blue and purple colors by the joint action of an alkaline base and the oxygen of the air. It is a mild astringent." "Contains tannin,—blue black variety."

8. *Purple Willow Herb* (Lythrum salicaria). "Showy purple flowers." "Is demulcent and astringent."

9. *Indigo.* "The complaints in which it has been employed with supposed advantage are epilepsy, infantile convulsions, chorea, hysteria and amenorrhœa."

10. *Phosphoric Acid* (PO_4H_3), the blue principle of Oxygen predominant. "When diluted is deemed tonic and refrigerant," "allaying spasms," etc.

11. *Sulphuric Acid* (SO_4H_2). Blue, indigo, and violet very strong. "Diluted, it is tonic, refrigerant and astringent."

12. *Nitric Acid* ($N_2O_5.OH_2$). Blue, indigo, etc. "Tonic and antiseptic." "Largely diluted with water, forms a good acid drink in febrile diseases."

13. *Hydrochloric Acid* (HCl). Blue-green, blue and indigo, of chlorine, and blue-green, indigo and dark violet of hydrogen, giving some preponderance of electricity. "Tonic, refrigerant and antiseptic."

14. *Tartaric Acid* ($C_4H_6O_6$). Blue and violet strongest. "Refrigerant."

15. *Tannic Acid* ($C_{27}H_{22}O_{17}$). In this important compound the powders of which are *light bluish yellow,* it may be supposed that the thermal principle rules from the amount of Carbon and hydrogen, but when we remember that it takes two atoms of hydrogen to balance one of oxygen as in water, and that hydrogen and even carbon are strong in the electrical colors, it may easily be understood why electricity as a whole has the mastery in this substance, although a part of the electrical atoms are encased in the yellow atoms of carbon. "The chief principle of vegetable astringents." "Used for hemorrhages," etc.

16. *Galls* (Galla). "The best are externally of a dark bluish or lead color, sometimes with a greenish tinge, internally whitish or brownish." "Astringent."

17. *Sulphate of Copper* (Cupric Sulphate, or blue vitroil SO_4 Cu. $5(OH_2)$. "Deep blue." "In small doses astringent; in large ones an emetic," from its yellow and orange principle.

18. *Ferrous Sulphate* (Green Vitriol, Fe SO_4). "Pale bluish green." "Astringent and tonic."

19. *Blackberry* (Rubus villosus). Violet colored juice. "Astringent."

20. *Chloroform* ($CHCl_3$). Strong blue and indigo, and some violet from preponderance of Chlorine. "A direct sedative to the nervous system, used as an anæsthetic by inhalation; but it frequently causes death by paralysis of the heart."

21. *Chloral hydrate* ($C_2HCl_3O.\ H_2O$). Predominance of blue, indigo and violet, but better balanced by thermism than chloroform. For the promotion of sleep as an anodyne, it is much inferior to opium. Generally its after effects are less disagreeable than those of opiates. "Considerably used in delirium tremens and tetanus." "Poison."

Green Tea (Thea viridis). "Green tea is characterized by a dark green color, sometimes inclining to blue or brown. Its infusion has a pale greenish yellow color." "Tea is astringent and gently excitant, and in its finer varieties exercise a decided influence over the nervous system," causing "exhilaration, wakefulness," etc. "Long continued in excessive quantity, it is capable of inducing unpleasant nervous and dyspeptic symptoms, the necessary consequence of over-excitement of the brain and nervous system. Green tea is decidedly more injurious in these

respects than black." Green tea has 17.8 per cent of tannic acid. The reader will readily see that the double quality of producing excitement and astringency comes from the yellow and blue which combine to produce the green.

XV. Healing Power of Blue or Violet Light.:—

NERVINE, ANTI-INFLAMMATORY, COOLING, ETC.

In other words blue, indigo and violet light heal on exactly the same principles as do the drugs already named, only in a more exquisite, penetrating and less harmful way, from the superior refinement of the elements thus received. To show that this is not mere theory, I will quote a few actual facts.

1st Case.—Sciatica, Inflammation, etc.

"An elderly lady on Hospital Place, off Lockwood street, has been afflicted with a sciatic difficulty for 11 years, and has not been entirely free from pain a single day during that time. Her age was 59, though she seemed to be 70. The disease was confined to the left limb, and the knee, ankle and foot would be swollen to twice their natural size. A week ago, 3 panes of blue glass were inserted in a west window, and the first bath was applied to the ankle where the pain and soreness were located. In two or three hours a large lump on the ankle the size of a hen's egg and of a purplish color, entirely disappeared, as did also the pain and soreness. During the following night, the pain reappeared in the foot, and the light being poor during the following two or three days, this point was not so easily relieved, but under a bath of strong light soon drove the peace destroyer away. But the most remarkable effect of blue glass sun baths on this patient was witnessed on Sunday. The disease attacked her knee Saturday night, and she suffered the most excruciating agony. Sunday morning the knee was very much swollen, and the least weight upon her affected parts nearly threw her into spasms. As soon as possible the blue glass bath was taken, and in less than three quarters of an hour the pain had left, the swelling and soreness had disappeared, and the limb was to all appearance as healthy as it ever was. Yesterday she walked about the house as lively as a girl of 16. Another remarkable feature in this

case is that for over a year the toes of the left foot have been entirely useless, being benumbed; but the blue glass sun-baths have restored to her the full use of those members.—*Providence Press, Feb. 14, 1877.*

2d Case.—Violent Hemorrhage of the Lungs.

"A lady of my family, about six weeks ago, had a violent hemorrhage of the lungs, and for ten days raised more or less blood daily. She was very much weakened by the loss of blood, and considerably frightened withal. I obtained some blue glass and placed it in the window where she was in the habit of sitting, the blue glass constituting one-half of the lower sash of the window. The lady sat daily in the associated lights, allowing the blue rays especially to fall upon the nerves of the back of the neck for about an hour a day. The second day, the sun's rays being unusually strong, she got 'too much blue glass,' and at night felt peculiar sensations in the back of the neck, among the nerves, and an unpleasant fulness in the head. These sensations wore off next day, and since then she has not remained so long at a time under the blue glass. But from the first she began to grow stronger, her face soon gained its natural fulness, and in a week she was, to all appearances, as well as ever. Of course, she was not cured of the trouble in her lungs in so short a time, but the soreness in her chest has passed away, and she begins to feel well again. After sitting in the associated light for a week, a large number of red pimples came out on her neck and shoulders, an indication that the treatment was bringing out to the surface the humors of the blood." *From "Dutton," N. Y., Jan. 12, 1877, in Correspondence of Chicago Tribune.*

The expression in the above "she got too much blue glass" is incorrect. It should have been *too much blue and transparent glass*, as the stimulating white rays of the sun were totally wrong for such a case. She had too little blue glass. Even the mazarine blue glass alone lets in too much of the other warmer rays to make it safe to take them on the head or upper spine for an hour at a time if the patient has a very sensitive brain or nervous system. This mistake results from the incorrectness of conception which would make one method a panacea for everything.

3d Case.—Cerebro-Spinal Meningitis.

General Pleasanton received a letter from a lady in Cairo, Illinois, who had been afflicted with a dreadful case of spinal meningitis, and after suffering four years was cured by the blue light process. *Condensed from N. Y. World.*

4th Case.—Neuralgic Headache.

A merchant on Broadway informed the author that he came home from church one Sunday with a severe neuralgia and headache, and although he had no special faith in the blue glass, concluded he would try it. By sitting under mazarine blue glass 30 minutes he was entirely relieved.

5th Case.—General Nervousness.

A benevolent lady physician of Vineland, New Jersey, informed me that she placed a large sheet of blue glass over one of her windows, and then set an easy chair in front of it, into which she invited her visitors. A feeble, nervous, elderly lady, who called frequently, was placed in the chair under the blue light. She immediately commenced improving, and after awhile concluded to ask the object of the blue glass in the window. After being told, she admitted that something had been making her feel much better, but could not tell before what it was.

6th Case.—Rheumatism.

The Hartford Post gives the account of a Mr. W. W. Larabee, proprietor of the Brower House, who was confined to his room with a severe attack of Rheumatism. A short course of blue sun baths gave him health and power to attend to business in a way which the paper calls "astonishing."

7th Case.—Rheumatism.

Dr. Robert Rohland of New York, in a letter to Gen. Pleasanton says: "I exposed, about a year ago, a man suffering with severe rheumatism to the influence of blue light through two glass panes. He felt, after 15 minutes, much relieved, and could move about without pains, but complained of a nasty metallic taste on his tongue."

Dr. Rohland speaks of another gentleman, a patient of Dr. Fincke, of Brooklyn, who, when his hand was placed in the blue light, experienced a taste like verdigris on his tongue. We have seen, Chapter Fifth XXI, 10, that copper, zinc and other metals must exist in blue light, although in that refined condition which prevents the poisonous effects of the crude metal.

8th Case.—Tumor on an Infant.

"In a little girl one month old, was found a hard resisting tumor about the size of a robin's egg, in the sub-maxillary region of the left side. I had it placed in such a position that the rays of light through a blue glass should impinge upon it, one hour at least each day. This tumefaction disappeared entirely within 40 days. The child has developed astonishingly; is now seven months old; is exceedingly bright and happy; has not known an hour's sickness or discomfort. Its peculiar freedom from infantile ills, I attribute, at least in some degree, to the influence of the Blue Light. Wm. M. McLaury (M. D.), *to Gen. Pleasanton in "Blue and Sun-Lights."*

If a lens had been used in the above case to concentrate the rays in one place, and yellow orange glass, which has the rousing power of yellow and red, to animate the nerves and blood, alternated at times with blue, the cure would doubtless have been performed several times as soon.

9th Case, or Series of Cases.—Colors for Lunacy.

The following treatment of lunacy in an Italian Asylum, I copy from a condensed report. The ideas are somewhat vague, but mainly correct as far as they go:—

Dr. Ponza, director of the lunatic asylum at Alessandria (Piedmont), having conceived the idea that the solar rays might have some curative power in diseases of the brain, communicated his views to Father Secchi of Rome, who replied: "The idea of studying the disturbed state of lunatics in connection with magnetic perturbations, and with the colored, especially violet light of the sun, is of remarkable importance." Such light is easily obtained by filtering the solar rays through a glass of that color. "Violet," adds Father Secchi, "has something melan-

choly and depressive about it, which, physiologically, causes low spirits; hence, no doubt, poets have draped melancholy in violet garments. Perhaps violet light may calm the nervous excitement of unfortunate maniacs." He then, in his letter, advises Dr. Ponza to perform his experiments in rooms, the walls of which are painted of the same color as the glass panes of the windows, which should be as numerous as possible, in order to favor the action of solar light, so that it may be admissible at any hour of the day. The patients should pass the night in rooms oriented to the east and the south, and painted and glazed as above. Dr. Ponza, following the instructions of the learned Jesuit, prepared several rooms in the manner described, and kept several patients there under observation. One of them affected with morbid taciturnity, became gay and affable after three hours' stay in a red chamber; another, a maniac who refused all food, asked for some breakfast after having stayed twenty-four hours in the same red chamber. In a blue one, a highly excited madman with a strait waistcoat on was kept all day; an hour after, he appeared much calmer. The action of blue light is very intense on the optic nerve, and seems to cause a sort of oppression. A patient was made to pass the night in a violet chamber; on the following day, he begged Dr. Ponza to send him home, because he felt himself cured, and indeed he has been well ever since. Dr. Ponza's conclusions from his experiments are these: "The violet rays are, of all others, those that possess the most intense electro-chemical power; the red light is also very rich in calorific rays; blue light, on the contrary, is quite devoid of them as well as of chemical and electric ones. Its beneficent influence is hard to explain; as it is the absolute negation of all excitement, it succeeds admirably in calming the furious excitement of maniacs."

The soothing power of blue as tested in a French Insane Asylum, is shown in this chapter, IV. 3. The idea that blue light is devoid of "chemical and electrical rays" shows the prevailing ignorance on the subject.

10th Case.—Sun-Stroke.

Dr. Rohland has called my attention to a remarkable cure published in the N. Y. Evening Post. A Mr. E., of Englewood,

and doing business in New York City, had suffered severely for two years from the effects of a sun-stroke, and by merely wearing a blue band on the inside of his hat was entirely relieved. This is a refutation of the absurd idea which some still entertain, that color has no potency excepting when the sun shines upon it. Sunlight stimulates all colors into greater activity, but all substances have their potencies according to their colors quite independent of light.

11th Case.—Sciatica, etc.

"Mrs. L., a widow aged 32, had been a severe sufferer for several years from *Sciatica*, with extreme tenderness in the lumbar region. We instructed her to sit daily for about two hours in a bath of all blue panes, with her back bared to the light. After the third sitting, the tenderness along her spine was almost entirely gone, while the distress and pain sensibly abated. This treatment continued but for ten days, when all symptoms disappeared." *Dr. Pancoast's Blue and Red Light*, p. 274.

12th Case.—Cholera Infantum and Marasmus.

"Master H., aged 18 months. This was a severe case of *cholera infantum* and *marasmus* brought on by teething in extremely warm weather; he had been under treatment by an excellent physician for some time, but was steadily declining. As the last faint hope we determined to try the *blue* treatment; he had been exceedingly irritable, but the blue light immediately soothed him into a gentle sleep and he came out of the bath calm and refreshed. Two months' treatment of him made him a fine healthy-looking child, with full, rosy cheeks and happy temper. We are confident that but for the blue ray this child must have died—no ordinary treatment could have saved him." *Blue and Red Light.*

13th Case.—Nervous Irritability.

Mr. T., aged 35. In consequence of long continued excessive physical and mental exertion, his nervous system was entirely disordered; the derangement manifested itself in nervousness, and trying irritability; he could not sleep at night, was disturbed

by frightful dreams ; his appetite was variable, sometimes ravenous, at others, the very sight of food was an annoyance ; his bowels varied, too, at times constipated, at others lax ; he had frequent pains in his head, the least excitement unnerved him, and he was inclined to extreme despondency. His irritability forbade red light, and we determined to administer blue light with red light medicine. The beneficial results were immediate ; his entire system improved rapidly ; five baths actually restored a healthy tone to his nervous system, and he has since experienced nothing even of "nervousness," though his life is one of constant physical and mental activity." *Blue and Red Light*, p. 280.

XVI. Healing Power of Blue and White Sunlight.

This combination, of course, is more rousing and animating than blue or violet light alone, as it contains the electrical power of the latter, and the healing power of all the rays combined in the ordinary white light. Gen. Pleasanton, who has demonstrated to the public the efficiency of combined blue and sunlight in vegetable growth and human healing, seems quite unacquainted with the principle by which this is done, as most persons must be who do not understand atomic law and the principles of chemical affinity. He concludes that, as the rays of the sun come 186,000 miles per second and are all intercepted excepting the blue by the blue glass, their impact upon the glass produces negative electricity, "while the electrical condition of the glass is opposite, or positive, and heat is therefore evolved by their conjunction. This heat sufficiently expands the pores of the glass to pass through it and then you have within the apartment electricity, magnetism, light and heat, all essential elements of vital force." With reference to the above, I would say, 1st, that we would have the electricity, light, heat, etc., if there were no glass used ; the same effects being produced by thin blue curtains, etc. ; 2dly, the meaning of the terms positive and negative electricity, as commonly used, being entirely unknown, their use tends principally to blind one by means of words which smack of science but signify nothing ; 3dly, the more the glass becomes heated by this action of sunlight, the more the

heat rays will fail to pass through, as heat is repellant. The diathermancy of blue glass is exceedingly small, while the blue substance, sulphate of copper, is said to shut off all heat as shown by experiment, although the substance itself becomes warm by absorbing the heat rays, and this is a substance which makes perhaps the purest blue glass, especially when ammonia is added, and constitutes *cupro-diammonium sulphate* $(N_2H_6Cu)\ SO_4$. Melloni has shown that plate glass shuts off over half of the heat rays of artificial light, while the mazarine blue glass must shut off more, and the cupro-sulphate blue the whole or nearly the whole. The blue should be understood to be of itself a cold electrical ray, so cold that when the thermometer stands at 56° F. in the blue rays of the spectrum, the yellow light will raise it to 62°, and the thermal to 79°, or nearly half as high again as the blue rays. How then does a mass of blue rays produce action when combined with a mass of white rays? We have seen in the Third and Fifth chapter that the blue color has a chemical affinity for the red, which being true, the blue rays of light must seize upon and combine with the red portion of the white light. I shall present facts a little farther on to show that while a small amount of blue with a larger proportion of white light will produce a greater heat than white light alone, yet an equal amount of blue and transparent glass placed side by side, is much more cooling than the ordinary transparent glass alone. In the following cases, which I quote mainly from General Pleasanton's work on "Blue and Sun-Lights,"* the blue light is probably in a considerable predominance so far as actual contact with the persons of the patients is concerned, and the effects already attributed to blue, are, as might be expected, the ones which generally appear. While the great error of General Pleasanton's book, therapeutically considered, is the one-sidedness of recommending blue and white light for everything, yet if we were to take one combination only, this is perhaps as good as any that could be selected, as it gives the penetrating, calming principle of blue, and the warming animating principle of white light, enabling one to take both at a time, with the head or any other warm and sensitive portion of the body under the

* I think the grammar of his title would have been better under the name of *Blue and White Sunlight*, for both colors belong equally to the Sunlight.

blue glass, while the colder portions are under the clear glass, or in case of fever or extra nervousness, to use the blue glass almost solely, while in case of a cold, dormant and chronic condition, the clear glass, or pure sunlight, should be used almost solely. In proving the advantage of the blue or violet combined with white light, in vegetable and animal life, Gen. Pleasanton has done a good thing for the world, and in spite of all his crude theories merits far more commendation than many of his critics who seem to have tried to offset his *facts* by their *prejudices*

1st Case.—Sciatica.

"About this time (Sept. 1871), one of my sons, about 22 years of age, a remarkably vigorous and muscular young man, was afflicted with a severe attack of sciatica, or rheumatism of the sciatic nerve, in his left hip and thigh, from which he had been unable to obtain any relief, although the usual medical as well as galvanic remedies had been applied. He had become lame from it and he suffered much pain in his attempts to walk. I advised him to try the associated sun and blue light, both upon his naked spine and hip, which he did with such benefit, that at the end of three weeks, after taking the first of these baths of light, every symptom of the disorder disappeared, and he has had no return of it since, a period now of three years." *Gen. Pleasanton's Blue and Sun-Lights, p. 14.*

2d. Case.—Two Cures of Rheumatism.

"Some time since, two of my friends, Major Generals S. and D. of the United States regular army, were on duty in this city. On making them a visit at their official residence, I saw on the window ledge, as I entered the room, a piece of blue glass of about the size of one of the panes of glass in the window. After some conversation, General D. said to me, Did you notice that piece of blue glass on the window ledge? I said I had observed it. 'Do you know what it is there for?' ** S. and I have been suffering very much from rheumatism in our fore-arms, from the elbow joints to our fingers' ends; sometimes our fingers were so rigid that we could not hold a pen—we have tried almost every remedy that was ever heard of for relief, but with-

out avail ; at last I said to Gen. S., suppose we try Pleasanton's blue glass, to which he assented—when I sent for the glass and placed it on the window-ledge. When the sun began about ten o'clock in the morning to throw its light through the glass of the window, we took off our coats, rolled up our shirt sleeves to the shoulders, and then held our naked arms under the blue and sunlight ; in three days thereafter, having taken each day one of these sun-baths for 30 minutes on our arms, the pains in them ceased, and we have not had any return of them since. We are cured.'

" It is now more than two years since the date of my visit to these officers. Two months ago Gen. S. told me that he had not had any return of the rheumatism, nor did he think that Gen. D. had had any. Gen. S. in the mean time had been exposed to every vicissitude of climate from the Atlantic Ocean to Washington Territory, on the Pacific, and from the 49th degree of north latitude to the Gulf of Mexico, and Gen. D. was then stationed in the far north." *Blue and Sun-Lights, p. 15.*

The foregoing and other examples illustrate the durability and power of the fine forces according to Chap. First, XV.

3d Case.—Nervous Prostration.

Statement made by a lady patient of Dr. Fisher, N. Y.:

" Having been an invalid for nearly three years, and for the last half of that time confined entirely to my rooms on one floor, I became so reduced by the long confinement, and my nervous system seemed so completely broken down, that all tonics lost their effects, sleep at nights could only be obtained by the use of opiates, appetite, of course, there was none, and scarcely a vestige of color remained either in my lips, face or hands—as a last resort I was placed, about the 19th of January, 1874, under the influence of the blue glass rays. Two large panes of the glass, each 36 inches long by 16 inches wide, were placed in the upper part of a sunny window in my parlor, a window with a south exposure, and as the blue and sunlight streamed into the room, I sat in it continuously. I was also advised by Dr. Fisher to make a regular sun bath of it ; at least, to let the blue rays fall directly on the spine for about 20 or 30 minutes at a time, morning and afternoon ; but the effects of it were too strong for

me to bear; and as I was progressing very favorably, by merely sitting in it in my ordinary dress, that was considered sufficient.

"In two or three weeks the change began to be very perceptible. The color began returning to my face, lips and hands, my nights became better, my appetite more natural, and my strength and vitality to return, while my whole nervous system was most decidedly strengthened and soothed.

"In about six weeks I was allowed to try going up and down a few stairs at a time, being able to test in that way how the strength was returning into my limbs, and by the middle of April, when the spring was sufficiently advanced to make it prudent for me to try walking out, I was able to do so.

"The experiment was made a peculiarly fair one by the stoppage of all tonics, etc., as soon as the glass was placed in the window, allowing me to depend solely on the efficacy of the blue light." *Blue and Sun-Lights, p. 25.*

In the above case the lady had a mass of blue glass sufficiently great to cover almost if not entirely the whole of her body which was very proper, as much of the white light would have been too exciting for so sensitive a person. A proper kind of blue would not have been thus "too strong" on the bare skin.

4th Case.—Neuralgia, Rheumatism, Nervous Exhaustion.

"In the latter part of August, 1871, I chanced to visit a physician of this city, of my acquaintance, whom I found to be in great distress, and plunged in the lowest despondency. On inquiring the cause he told me he feared he was about to lose his wife, who was suffering from a complication of disorders that were most painful and distressing, and which had baffled the skill of several of the most eminent physicians here, as also others of equal distinction in New York. He then stated that his wife was suffering great pains in the lower part of her back, and in her head and neck, and also in her lower limbs; that she could not sleep; that she had no appetite for food and was rapidly wasting away in flesh; and that her secretions were all abnormal." [Here is given an account of her commencing the use of blue and white light, her husband having placed alternate blue and clear panes of glass in one window.]

"Six days after this interview, I received a note from the doctor, asking me to send him some copies of my memoir on blue light, etc., which he wished to forward to some of his distant friends, and at the close of it he had written: 'You will be surprised to learn that since my wife has been under the blue glass, the hair on her head has begun to grow, not merely longer but in places on her head where there was none, new hair is coming out thick.' This was certainly an unexpected effect, but it displayed an evident action on the skin, and so far was encouraging. Two days after the receipt of this note, I called to see the doctor, and while he was giving me an account of the experiment with the blue light, his wife entered the office, and coming to me, she said, 'Oh, General! I am so much obliged to you for having recommended to me that blue light!' 'Ah!' said I, 'is it doing you any good?' 'Yes,' she said, 'the greatest possible good. Do you know that when I put my naked foot under the blue light, all my pains in the limb cease? * * My maid tells me that my hair is growing not merely longer on my head, but in places which were bald, new hair is coming out thick.' She also said that the pains in her back were less and that there was a general improvement in the condition of her health.

"Three weeks afterward, on visiting them, the doctor told me that the arrangement of blue and sunlight had been a complete success with his wife; that her pains had left her; that she now slept well; her appetite had returned, and that she had already gained much flesh. His wife a few moments afterward, in person, confirmed this statement of her husband, and he added:—'From my observation of the effects of blue and sunlight upon my wife, I regard it as the greatest stimulant and the most powerful tonic that I know of in medicine. It will be invaluable in typhoid cases, cases of debility, nervous depressions and the like.'" *Blue and Sun-Lights, p. 10.*

The above mentioned physician is Dr. S. W. Beckwith, Electrical Institute, 1220 Walnut St., Philadelphia. I have not space here for his letter confirmatory of the above, and speaking enthusiastically of General Pleasanton's theory for the improvement of vegetable, animal and human life by these arrangements of colors.

5th Case.—Infantile and Animal Growth.

The following is a part of a letter from Commodore J. R. Goldsborough, of the U. S. Navy, dated Mound City, Ill., May 31st, 1872, and addressed to Gen. Pleasanton. After speaking of the extraordinary growth of plants which he had caused by alternate blue and plain glass, he speaks of two broods of chickens hatched on the same day, one of which was reared under an ordinary coop and the other "partly covered with blue and plain glass." "The chickens of each brood," he continues, "were fed at the same times, and with equal quantities of similar food. Those under the blue glass soon began to display the effects of the stimulating influence of the associated blue and sunlight by their daily almost visible growth, increase of strength and activity, far exceeding in all these respects, the developments of the chickens of the other brood which were exposed to the ordinary atmospheric influences.

"I will also relate to you what I imagine to be another remarkable circumstance having relation to this subject.

"On the 29th of January, 1872, the wife of one of the gentlemen on the station gave birth prematurely to a very small child, which weighed at the time only 3½ pounds. It was very feeble, possessing apparently but little vitality. It so happened that the windows of the room, in which it was born and reared, were draped with blue curtains, through which, and the plain glass of the windows, the sunlight entered the apartment. The lacteal system of the mother was greatly excited, and secreted an excessive quantity of milk, while at the same time the appetite of the child for food was greatly increased, to such an extent indeed that its mother, notwithstanding the inordinate flow of her milk, at times found it difficult to satisfy its hunger.

"The child grew rapidly in health, strength and size; and on the 29th of May, 1872, just four months after its birth, when I saw it, before I left Mound City, it weighed 22 pounds." *Blue and Sun-Lights, p. 7.*

With reference to the above I would simply remark that a thin, somewhat gauzy, blue curtain would doubtless be desirable, for in case a curtain is too thick it would become nearly opaque, and thus absorb the blue rays before they reach the patient. Glass, when convenient, is doubtless best.

6th Case.—Partial Paralysis in a Child.

"Sometime since, Mrs. C., the wife of Major-General C., a distinguished officer of the U. S. regular army, told me that one of her grandchildren, a little boy about 18 months old, had from his birth had so little use of his legs that he could neither crawl nor walk, and was apparently so enfeebled in those limbs that she began to fear that the child was permanently paralyzed in them. To obviate such an affliction, she requested the mother of the child to send him with his two young sisters, to play in the entry of the second story of her house, where she had fitted up a window with blue and plain glass in equal proportions. The children were accordingly brought there, and were allowed to play for several hours in this large entry or hall under the mixed sun and blue light. In a very few days, Mrs. C. told me that the child manifested great improvement in the strength of its limbs, having learned to climb by a chair, to crawl and to walk, and that he was then as promising a child as any one is likely to see." *Blue and Sun-Lights, p. 22.*

Parents, especially those whose children are somewhat nervous and feeble, should take a hint from the above and have their nurseries arranged accordingly. Some blue and violet glass in the windows would tend to quiet the brains and stimulate the nutritive functions of children, who in our climate tend rather to over activity of brain and nerves.

7th Case.—Spinal Meningitis and Baldness.

Gen. Pleasanton relates an agreeable incident which occurred to him but a few weeks since. "A lady and her daughter called to see him, and announced that they had come from Corning, N. Y., to Philadelphia, for the express purpose of thanking him for saving the daughter's life.

"Four years ago she was afflicted with a violent attack of spinal meningitis. Her sufferings were indescribable but continuous. Every conceivable remedy had been resorted to during these four years, but the patient received no benefit. Her nervous system at last became so disordered that the slightest sound, or the most gentle agitation of the air, threw her into the most agonizing suffering. She was wasted away in flesh, could not

sleep at night, had no appetite, and her life was despaired of. Hearing of Gen. Pleasanton's discovery in associated lights, her parents determined to try it. A bay window was fitted with alternate panes of blue and plain glass, and the young lady sat daily in the light which streamed through them. Her physicians, of course, laughed at the idea, pronounced the whole thing a humbug, etc., as is the habit of professional gentlemen whenever any new idea is broached. The physician was dismissed, and the young lady relied wholly upon the blue-glass treatment for her restoration to health. The lady says that on entering the room thus lighted, the pains from which she was suffering almost immediately ceased. They would return in a modified form on leaving the room, but grew less from day to day. Very soon her condition began to improve, her appetite returned, and with it her strength; she began to gain flesh, her sleeplessness disappeared, and in short, she was speedily restored to health.

"A singular feature of this young lady's case was that her hair all came out and she became as bald as an egg. Her physician examined the scalp with a microscope, and declared that there were no roots of hair remaining, and that, consequently, she would never again have a natural head of hair. This announcement, to a young lady, was worse than would have been the reading of her death-warrant. Better the cold grave and its attendant worms than to go through life with a wig. Under the blue-glass treatment, however, the hair did begin to grow, the young lady discarded her wig, and when she called upon Gen. Pleasanton she showed him a luxuriant growth of hair, which any young lady might envy. She was profusely grateful to the General for having restored her hair, and incidentally saved her life. So much for examples and illustrations. These and numerous others which I might cite if you had space to print them, show that the blue associated with the sunlight has a wonderfully stimulating effect upon both vegetable and animal life." *Correspondence of the Chicago Tribune, dated Jan. 12, 1877, by Dutton.*

An account of the same case was given in the New York Tribune. I have caused a new and rich growth of hair in several persons by manipulating the scalp with the ends of my fingers, and thus animating it with vital force. How much safer to use these finer forces for the head than the many preparations

which poison the system and sometimes induce paralysis and insanity.

8th Case.—Concussion and Inflammation.

The following is a portion of a letter dated Jan. 23, 1877, to the Chicago Tribune by General Pleasanton and relates to a severe fall which he received in alighting from his carriage:—

"My right shoulder, right dorsal muscles, and right lumbar region received the shock of the fall. Fortunately, my head did not strike the pavement. The concussion knocked the breath out of my body, and it was a considerable fraction of a second before I could have an inspiration of air. Some gentlemen kindly picked me up, and assisted me into the nearest store. At the expiration of an hour I was sufficiently recovered to be enabled to call upon my family physician, who lived about a square distant, by whom my body was carefully examined. He said that there had been no fracture of ribs or bones, but that I had received a very severe contusion, the effects of which I would feel for some time at my age. I knew that such an opinion meant long protracted suffering with very little hope of relief from any process *secundum artem.* He prescribed soap liniment to soften the muscles of the injured parts; it afforded no relief. The pains were very great and constant, and, in a paroxysm of coughing, I experienced the most intense pain in the back part of my right lung, which I thought had been brought into contact with the inside of my ribs when I fell. Inflammation of the lung, with its consequent attachment to the inside of the ribs, immediately recurred to my imagination, and the doctor was again invoked. He prescribed a porous plaster to confine the muscles, so that, in the act of coughing or sneezing, the pain might be mitigated, but it afforded no relief. The next day there was a bright sunshine and a clear atmosphere. In my bathroom I have a window with a southern exposure, arranged with alternate panes of blue and plain, transparent glass. I determined to try the efficacy of a sun-bath with blue glass. Accordingly, uncovering my back, I sat with it to the blue and sun lights, which were streaming through the window into the bathroom. As soon as these lights began to fall upon my back the pains began to diminish, and

at the end of half an hour they had ceased altogether. Towards evening the pains returned ; but they were much less than they had been before I had taken the blue-light bath, and during the night I was easier than I had been previously. The next day we had again a brilliant sunshine, clear atmosphere and low temperature ; and, intending to take another bath of blue and sunlight, I sent for my physician, that he might witness the effect for himself. He is the very eminent surgeon, Dr. D. Hayes Agnew, Professor of Surgery and Anatomy in the University of Pennsylvania.

"He arrived while I was taking this bath, and was shown up into my bath room. On coming into the room I said to him, 'Doctor, I am glad you have come at this time. I am taking a bath of blue and sun lights.' He replied, with a smile of incredulity as to its effect, 'I see you are ;' and I said, 'It is doing me great good ; it is relieving all my pains ; and I wish to give you some information that you should know. Will you be good enough to place your naked hand on that pane of transparent glass, through which the sunlight is streaming into the room ? You will find it as cold as the outer atmoshere, which is at freezing temperature.' He placed his hand on it, and said, 'Yes, it is very cold.' 'Now,' said I to him, 'put the same hand on the next pane of glass, which is blue ; you will find it hot.' He did so, and, in the greatest surprise, said, 'Why, I never knew that !' 'Of course you did not,' I replied ; 'that is one of my discoveries, that I have been trying to pump into you doctors for the last fifteen years, but without effect.' He then said, 'This is very wonderful ; I had no idea of it before.' Then he said. 'This room is very warm ; have you any fire to heat it ?' I answered, 'No ! The windows and the southern and western walls are in contact with the outer air. The adjoining chamber on one side, and the staircase on the other, are each without artificial heat.' 'Then,' said he, 'how do you make it so warm ?' 'That,' I said, 'is another of my discoveries, and is produced by the conjunction of the opposite electricities of sunlight and blue glass !'"

The fact that so learned a gentleman as Dr. Agnew was not aware that blue glass under the influence of luminous rays is warmer than clear glass, shows how uninformed our medical men

are concerning some very simple facts in connection with these fine potencies, and for Gen. Pleasanton to say "that is one of my discoveries," shows that he is not very familiar with the principles of optical science as already developed.

9th Case.—Rheumatism, etc.

Dr. Robert Rohland having referred me to Mrs. William Proessel, of No. 20 East 42d st., N. Y., as a very remarkable cure by sunlight, I was led to make a personal and careful examination of the same. She has been a severe sufferer from rheumatism for eight years as a reactive effect of uterine difficulties, her knees were badly swollen and hardened at the joints, limbs made crooked, finger joints enlarged, and fingers badly contracted by the flexor muscles, left arm and shoulder seemingly paralyzed, and she altogether so helpless as to have to be carried to different parts of the room by her friends. She tried nearly every style of treatment in vain, as nothing but the blue and white sunlight combined has ever succeeded in bringing her steadily and thoroughly forward. Her windows are prepared with about half a pane of blue glass set up against one side of each pane of clear glass. This she found to be more soothing than when set up in the middle of a pane of clear glass, each kind of light thus being made to come in larger masses. She has blue-green shades by which she regulates the quantity and locality of the light. She has been in the habit of taking the light not only on the knees, but on the whole spine including a little of the cerebellum. Although taking it upon the bare skin even in winter, she did not suffer with the cold after getting the light fairly upon her. When the blue light struck her, its immediate effect was to make her feel cold, but almost instantly a reaction would give her warmth. She says it would often seem as though flies were touching her skin where the blue and white light joined. This shows the electrical and chemical action evolved by the two styles of light.

She has already used the above for 8 or 9 months, commencing early in the Autumn of 1876, and extending onward during the good days of the following winter and spring, and can now walk freely with only a slight limp, the knees have assumed their usual size, the arm and shoulder are well, the fingers have

become straight and the joints nearly their proper size, and although not yet a strong person, she is like a transformed being as compared with her past.

I have pointed out to her what, as it seems to me, have been mistakes in her method of using the light, 1st, that which comes from following Gen. Pleasanton's rule of having equal amounts of blue and clear glass, which, in her very sensitive and nervous condition, caused too much excitement, pain, and sometimes sleeplessness, leading her at times to resort to quieting drugs which have a bad after effect. In the process of arousing a dormant system, deadened by chronic diseases, all thorough radical treatment must arouse more or less of acute pain and bring up perhaps old symptoms which for the time being lead the uninformed to think they are growing worse, but in such a case when the pain becomes too severe, a resort for a time to nothing but the blue or violet light would give relief; 2dly, as soon as her arm and shoulder had been relieved, it would have been well not to have taken the light so near her brain, as it often caused pain in the head: when she first commenced, she could not endure the light thus over ten minutes at a time, but afterwards she came gradually to use it several times as long; 3dly, she has wholly neglected to use the light on her liver, stomach, lungs and bowels, consequently her vital processes have not been as greatly animated and strengthened as might have been done.

Miscellaneous Cases.

I will merely mention the following cases, given in *Blue and Sun-Lights* by Gen. Pleasanton, as treated by blue and clear glass:—

1. *Major-General Chas. W. Sanford's invalid daughter* "materially benefited."

2. *Henry H. Holloway*, of 5 South 10th st., Philadelphia, cured of *rheumatism* of nearly two months' standing by 3 or 4 sunbaths of blue and white light. His mother, also, relieved of severe sickness.

3. Two *lambs*, newly born, weighing respectively $3\frac{1}{2}$ and 4 pounds, were placed in a pen fitted with blue and uncolored glass, "fed alike with skimmed cow's milk," and at the end of 3 months weighed, respectively, 55 and 51 pounds.

4. Several cases given which show that *flies and hurtful insects* are killed under blue glass or blue gauze.

5. Remarkable increase of *vegetable growth* caused, which will be noticed in the next chapter.

6. A mule cured of *deafness and rheumatism* by having its head and neck illuminated by the blue and white light which came through transoms.

7. The hatching of *silk-worms* greatly facilitated by violet glass.

8. Marvelous development of an *Alderney calf*, which was supposed at first by the keeper, to be too feeble to live.

XVII. When Blue and Violet are Injurious.

1. All the electrical colors, including the various shades of blue, indigo, violet, and even blue green, are too cooling and constricting in general cases of paralysis, costiveness, chronic rheumatism, and gout, consumption (the acute forms excepted), and all cold, pale, and dormant conditions of the system, although the brain, especially its upper portion, may, quite generally, even in these conditions be put under blue glass to advantage. In all cases of melancholia, and depression, these electrical colors are contra-indicated, as a person who has what is called *the blues*, is already sufficiently supplied with that article without having any more of it.

2. Dr. Pancoast, of Philadelphia, who has a considerable experience in healing by means of colored lights, speaking of blue light, says: "Its action is as pronounced in reducing, as that of the red is in producing, nervous excitement. If administered in small doses, it acts as a gentle sedative, creating a disposition to sleep, but as soon as this effect is reached, the bath should cease. In cases of extreme nerve tension, when prompt action is imperatively demanded, we employ a pure blue bath, but this is rare, and as there is always danger in so large a dose, we are very careful to note the momentary effects, lest the patient be reduced to a condition of extreme prostration—sometimes the lapse from intense excitement to as extreme prostration is sudden. As a general rule, a dose in ordinary cases would be a bath of about two hours, through a window containing alternate blue and plain glass." Dr. Pancoast has thus made his bath much longer,

I think, than most persons could comfortably endure, especially if their heads were to be exposed to the full light of clear glass in the mid-summer of our American climate. In England, Russia, or Prussia, a sun-bath could be taken with impunity for a much longer time than in Italy, Greece, India, Spain, or even in France or Austria, and in winter perhaps twice or thrice as long as in summer. I once took a seven hour sun-bath on the upper deck of one of our steamers as it passed through the New York Bay, and a short distance into the ocean, during a hot July day, but the electricity of a constant breeze sustained me, and the only damage I received was that the skin of my hands and face became somewhat burned, but was soon relieved by the use of blue glass and a little glycerine. The new animation of body and mind canceled this little drawback many times over.

XVIII. Healing by means of Substances charged with Blue Light.

1. Light being an actual substance moving with peculiar styles of vibrations according to the particular colors which compose it, and at a rate of nearly 186,000 miles a second, it is easy to see that it must have great power, and that the substances receiving it must partake of this power. The fact that the whole world, mineral, vegetable, and animal, is ever being transformed into new and beautiful growths, forms and colors under its magic touch, shows its almost omnific power.

2. Reichenbach proved by many experiments upon persons of very delicate sensibilities, whom he called *sensitives*, the great and peculiar power of sunlight. Sometimes he would carry a long copper wire, one end of which they held in a dark room, and without their knowledge, would place a plate of metal attached to the other end directly in the rays of the sun. The sensitives would feel it immediately and powerfully as an icy cold principle, so cold in fact that it would stiffen their hands. Baron Reichenbach took this as a proof that the finer elements of sunlight are cold. This is true so far as its electrical rays are concerned, but the cold which they felt so powerfully may be accounted for on the principle that thermo-electricity was evolved

by the heating power of the sun's rays, the natural tendency of electricity being always to move from a hot to a cold portion of an object.

3. Reichenbach had water stand in the sunlight five minutes, when Miss Maix, on drinking it without knowing what was done, said immediately that it was magnetized. "It produced the peculiar pepper-like burning, well known to the sensitive, on her tongue, palate, throat, down to the stomach, at every point arousing spasmodic symptoms." Water which stood twenty minutes in the sunshine, was found to be as strongly magnetic as it could be when charged with a large nine layered magnet. "I allowed Miss Reichel to become used to the feeling of my hand, and then went out into the sunshine. After ten minutes had elapsed, during which time I had exposed myself on all sides to the sun's rays, I went back and gave her the same hand. She was much astonished at the rapid alteration in the great increase of force which she experienced in it, the cause of which was unknown to her. The sun had evidently impregnated me in exactly the same way as a magnet had charged the body of a man" (in a previous experiment). Reichenbach further affirms that Miss Maix could not bear the increased power of persons coming out of strong sunlight, and that iron, glass, or any other object could be charged with a power which affected her like a magnet, while a magnet which had become weak was made strong by being placed in the sun, thus confirming the observations of Barlocci, Zantedesschi and others concerning solar magnetism.

4. A substance called *Od-sugar* or *Odo-magnetic sugar* has been devised and used with remarkable success as a curative agent by Adolph von Gerhardt, M.D., of Germany, and also prepared and supplied by Robt. Rohland, M.D., of 429, 2d Ave., New York. It consists of the sugar of milk charged by certain rays of the sun through a prism, being called *od-sugar* from the fact that a certain amount of *odic* or *od* force is brought into action by means of the sunlight, although the sunlight itself must be the more immediate potency. When the sugar is charged by the thermal rays it is called *positive odo-magnetic sugar;* when charged by the electrical rays, *negative odo-magnetic sugar,* or *negative od-sugar,* terms which are not very accurate, as the word

positive naturally means strong or aggressive, while *negative* means weak or yielding. Surely the wonderful chemical potencies of blue and violet cannot be called negative in their character, for in many combinations the red and yellow are most feeble in comparison. Thermo-od-sugar and electro-od-sugar would discriminate better. In Dr. Rohland's pamphlet he says, "If a part of the sugar becomes placed within the solar spectrum in the *red* and *yellow* rays, and another part in the *blue* and *violet* rays of the sunlight, and a sensitive tastes them after some time of exposure, the first will taste tepid and nauseous, and the latter cool and refreshing." This admirably confirms what we have already seen to be the true potencies of color, the red and yellow drugs being more warming and nauseating and including the emetics, while the blue and violet ones are cooling and soothing to the nerves. I will quote from Dr. Rohland's pamphlet a little of the testimony of physicians, some of whom I am acquainted with and know to be eminent in their profession. This testimony is with reference to the electro-od-sugar, and shows its quieting, cooling, soporific character according to the principles which I have already given.

CASE 1st.—PHTHISIS PULMONALIS, SLEEPLESSNESS, etc.

"The patient was very weak, very sallow, and the eyes looked strained and staring; sleepless, expectoration of purulent taste. After "Od," one dose,* reports: Slept well, feels better and stronger than he has for a month, looks fresher in the face and eyes, the expectoration tastes salty—cough unchanged." S. SWAN, M.D., 13, West 38th St., N. Y., Nov. 8, 1870.

2d CASE.—NASAL AND BRONCHIAL CATARRH, NERVOUSNESS, etc.

"A young lady from Philadelphia, * * was much reduced in strength and vitality, extreme excitability of the nervous system—raised blood and pus from the bronchia or lung; could not sleep. First night, gave her pulsatilla—no relief; then nux vomica—no better. I then, the third night, gave her one odomagnetic sugar powder. Result: sound sleep all night—the first she had had for more than two months—much refreshed in

* A dose is half a grain or about what would lie on the point of a knife. Double this amount I have found to be more effective.

the morning." O. R. GROSS, M.D., 273, *West 52d St., N. Y., Aug.* 28, 1870.

3d CASE.—CONVULSIONS.

"The child of Mr. Mailander, a mechanic near Jena, $1\frac{1}{2}$ years old, had been lying with the most fearful attacks of cramps for four hours, so that the parents as well as the physician declared it hopelessly lost. Good luck happened to make me pass near his house; I was called in and saw the child lying in terrible convulsions. I chanced to have a flask of od-negative (electro-od) milk-sugar with me, so I poured a blade's end full of it into his mouth. Scarcely 15 minutes elapsed when the cramps, to my great surprise and that of every one else, ceased altogether and the child became perfectly well again." ADOLPH VON GERHARDT.

4th CASE.—MENORRHAGIA AND TOOTHACHE.

"On the 4th of Aug. 1870, I gave Dr. St. Clair Smith, Physician of the "Five Points House of Industry," two doses of my odo-magnetic milk-sugar. Yesterday (Sept. 12, 1870), he bought a flask of the sugar, and on this occasion told me the following:

"One of his lady patients suffered from profuse menstruation; another from violent toothache, and each was completely cured 15 minutes after the odo-magnetic sugar had been taken. The two patients themselves could not comprehend it; but as Dr. Smith, having had two doses only, could not continue the medicine, the sufferings returned next day." ROBT. ROHLAND, M.D.

Dr. Rohland says that "every physician, without one exception, who has tried this odo-magnetic milk-sugar, even with great reluctance and caution, has had to report some great results; some in *intermittent fever* with China, when the latter had failed by itself; others in *headache, toothache;* some in *diarrhœa,* or other disorders of the *digestive organs,* in *fits* and *hemorrhages;* and every one in *nervous debility, nervousness, weakness, sleeplessness, depression of mind,*" etc. etc.

In IX of this chapter, the reader will see a simpler method of gaining the potencies of blue and violet light in connection with water, which the author has devised, and also a number of

examples in which the yellow and red principles have been developed in connection with water and given with marked success for animating the system, acting as a laxative, alterative, etc. Dr. Von Gerhardt did not seem to have ascertained the potencies of the thermal colors, although they are perhaps more practical and valuable than those of the electrical colors taken all in all.

5th CASE.—DIARRHŒA CURED WITH BLUE-CHARGED WATER.

Although the blue and violet principles are especially valuable for checking nervous and inflammable conditions, I have in several instances checked the too free action of the bowels by light strained through blue glass placed over the bowels, or by water charged in blue bottles, or blue chromo lenses.

Miss K., formerly a patient of mine, living on Broadway, was becoming haggard in her appearance from diarrhœa which had lasted five weeks. I handed her a blue bottle which I had filled with water, and had standing in the sun for a part of a day. She drank something like a tablespoonful of this two or three times a day. In one or two days her diarrhœa ceased, and up to this time, several months having elapsed, it has not returned. A favorable symptom in the case is that she did not swing to the other extreme of constipation, as would very likely have occurred under an opium treatment. It should be remarked that she took only an occasional sip of the water after the first day or two. The blue chromo lens, to be described hereafter, is still better.

XIX. HEALING POWER OF PURE SUNLIGHT.

Pure white light, as nature gives it to us, is of course far more desirable for man than any one color of sunlight, for in this we get all colors and all potencies combined. While many conditions of disease and perhaps imperfections of climate may be improved by a predominance of some one or more colors as brought about through prisms or colored glass, the combined rays, as in white light, are the ones which man and nature must generally depend upon, and which most of all they require. *Although sunlight combines both the thermal and electrical rays, covering every variety of power, yet as a whole, especially in warm weather, it is powerfully heating and stimulating in its nature,*

kindling into action dormant systems and proving to be over-exciting especially when falling on sensitive brains. By exposing any portion of the body to the sun not to an undue extent, the skin becomes somewhat darker, clearer and more rosy in its general character, having on the whole a richer effect than the waxy whiteness of bleached indoor faces. The darker and more rubicund appearance comes from the carbon which is driven into the skin by the light, and being of the right color to stimulate the nerves of the surface, the blood is more or less drawn there and thus a more rosy appearance is developed. This gives an activity and toughness to the cuticle which enables it to resist many external influences of the atmosphere, and often prevents the *taking of cold*, while it also withdraws heat and inflammation from the internal organs. Light which has passed through glass must be somewhat softer and more refined than the full glare directly from the sun, as it is strained of some of its coarser elements and some of the intensity of its heat. This, of course, makes it less desirable when the greatest external power is required. I will quote a very few cases of sun-healing.

1st Case. Prevention of Colds, etc.

The toughening power of the sun was well illustrated some years since in the case of a lady patient of the author. She was very feeble and negative, and every little exposure would cause her to take cold. She took a course of sun-baths on the skin over the lungs and other parts of her body, since which she rarely if ever takes cold. In this respect she has become permanently strong, as years have elapsed without a recurrence of her old conditions.

2d Case, or Series of Cases. Cure of Tumors, Mother's Marks, etc.

The following, taken from the N. Y. "Herald of Health," is from the pen of Augustus Barnes, who remarks that he has studied the hygienic properties of light for 38 years:

"I can remove cancers in their earlier stages, tumors, *nævus maternus* (or mother's marks). It matters not whether the latter are red, black, purple, brown, or other color, or whether they

cover the entire side of the face, or large protuberances appear, I remove all by a lens and the simple rays of the sun, without starting a drop of blood, or leaving a scar but for a short time. There is less pain attending this operation than by common surgery. Uncomely moles that disfigure the face of many persons can be made to disappear and leave the face as fair as Nature intended it, nor do they ever reappear. This treatment produces no ill effects, for there is no mineral or chemical poison in the rays of the sun.

ADVANTAGES OF THE SUN'S RAYS OVER ALL OTHER CAUSTICS AND THE LANCET.

1. There is no mutilation of any part, nor is a drop of blood ever drawn. The sun's rays will cauterize a vein or an artery so as almost instantly to stop their bleeding.

2. There is no after dressing needed, except for cancers.

3. There are no bad effects resulting from poisoning, for the sun's rays are not poisonous.

4. There is no scar left, after a sufficient time has elapsed for the healing process; and the redness caused by the burning will disappear in from one to six months.

5. Those who have been subjected to both systems express themselves as feeling less than half the pain under the sun's rays.

6. No detention from business is required.

7. There is no fainting under the operation.

8. Anæsthetics are rarely required.

9. The quickness and permanence of the treatment and the simplicity of the operation are remarkable. It is easily controlled, and the operator can burn to a considerable depth, or so slightly as to only destroy the cuticle, stopping the cauterization at whatever stage he pleases.

10. The remedy is to be found wherever the sun shines, requiring no preparation, no grinding, no mixing, but is ready every day and free to all."

With reference to the above it should be remembered that the blue is the balancing principle where too much of the red or inflamed condition exists, while the yellow-orange is the great animating principle in hard tumors or other dormant conditions,

for which reason the blue chromo-lens and the yellow-orange chromo-lens, to be described hereafter, would be superior to one which is transparent, in certain cases.

3d. Case.—Complication of Diseases.

"A very remarkable instance of recovery from disease has been related by the late Baron Dupuytren, the eminent French surgeon. A lady, residing in Paris, had suffered for many years from an enormous complication of diseases, which had baffled the skill of all her medical advisers, and her state appeared almost hopeless. As a last resource, the opinion of Dupuytren was requested upon her case, and he, unable to offer any direct medical treatment essentially differing from all that had been previously tried in vain, suggested that she should be taken out of the dark room in which she lived, and away from the dismal street, to a brighter part of the city, and that she should expose herself as much as possible to the daylight. The result was quickly manifest in her rapid improvement, and this continued until her recovery was complete. An equally singular instance has been related by Southey, in the case of his own parent." *Dr. Forbes Winslow's "Influence of Light," p. 171.*

XX. Disastrous Effects of a Lack of Sunlight.

1. Sir James Wylie says that "the cases of disease on the dark side of an extensive barrack at St. Petersburgh, have been uniformly, for many years, in the proportion of 3 to 1 to those on the side exposed to strong light."

2. Dr. Forbes Winslow in his volume entitled "Light; its Influence on Life and Health," uses the following language :—

"It may be enunciated as an indisputable fact, that all who live and pursue their calling in situations where the minimum of light is permitted to penetrate, suffer seriously in bodily and mental health. The total exclusion of the sunbeams induces the severer forms of chlorosis, green sickness, and other anæmic conditions depending upon an impoverished and disordered state of the blood. Under these circumstances the face assumes a death-like paleness, the membranes of the eyes become bloodless, and the skin shrunken and turned in a white, greasy, waxy

color ; also emaciation, muscular debility and degeneration, dropsical effusion, softening of the bones, general nervous excitability, morbid irritability of the heart, loss of appetite, tendency to syncope and hemorrhages, consumption, physical deformity, stunted growth, mental impairment and premature old age. The offspring of those so unhappily trained are often deformed, weak and puny, and are disposed to scrofulous affections."

3. Dr. Ellsworth, of Hartford, says : "Take a rabbit and shut him from the sunlight, and he will die of consumption in a few weeks. The tubercles will be just as perfectly formed in his lungs as in the human species, and the symptoms in every respect will be the same."

4. Many persons keep themselves pale and sickly by means of parasols, unbrellas, shaded rooms, and in-door life generally. Parasols should be dispensed with excepting in the hottest seasons. Sailors who are ever in the pure air and sunlight, and children who play much out of doors, generally present a ruddy, healthy appearance. The following severe cut on our American house-keepers, from an editorial of the Chicago Tribune, is well merited :—

"In this country, there seems to be an implacable feud between people and the sun—the one striving vigorously and even fiercely to get into the houses, and the other striving just as fiercely and vigorously to keep him out. The average American housekeeper does not think she has fulfilled her whole duty until she has made the rounds of the whole household, shut all the doors, closed all the shutters, and drawn all the curtains on the east and south sides of the house. This is the morning's job. In the afternoon she makes the same grand round on the west side of the house. She is not quite happy and contented until the sun has gone down and darkness sets in. She is substantially aided in her raid against the sunlight by the heaviest of shades, curtains and lambrequins. Thus the fight goes on day by day and season by season. In summer she shuts out the sun because it is too hot. In winter she shuts it out because it will spoil her carpets. In spring and fall she has other reasons. She has reasons for all seasons. Thus she keeps the house in perpetual shade, in which the children grow up sickly, dwarfed, full of aches and pains, and finally have to be sent off into the

country post-haste so that they may get into that very sunlight which they have been denied at home, and in which the country children run and are glorified."

5. Our *Street-Car and Railroad Conductors* are too often most careful to shut out the sun from their vehicles, even in weather when it would be especially delightful and animating to have its rays. In fact this glorious orb of heaven is frequently treated as if it was man's deadliest enemy, instead of being the dispenser of power and beauty in all directions, as it really is.

6. The ancients often had terraces, called *Solaria*, built on the tops of their houses, where they were in the habit of taking their solar air baths. Pliny says that for 600 years Rome had no physicians. Using such natural methods of retaining or gaining physical power as vapor baths, manipulation, sunlight, exercise, etc., they became the mightiest of nations. By this remark I throw out no slur against true and wise physicians, who are blessings to a community, but would call their attention more to nature's finer methods rather than to the use of so many drugs, blisters, moxas, bleedings, leechings, and other violent processes which so weaken and destroy the beautiful temple of the human body.

7. "Who has not observed the purifying effect of light," says the beloved Florence Nightingale, "and especially of direct sunlight upon the air of a room? Go into a sick room where the shutters are always shut (in a sick room or bed-chamber there should never be shutters shut), and though the room has never been polluted by the breathing of human beings, you will observe a close, musty smell of corrupt air, *i. e.* unpurified by the effect of the sun's rays. The mustiness of dark rooms and corners, indeed, is proverbial. The cheerfulness of a room, the usefulness of light in treating disease, is all-important. 'Where there is sun there is thought.' All physiology goes to confirm this. Where is the shady side of deep valleys, there is cretinism. Where are cellars and the unsunned sides of narrow streets, there is the degeneracy and weakliness of the human race, mind and body equally degenerating. Put the pale, withering plant and human being into the sun, and if not too far gone, each will recover health and spirit." *Notes on Nursing.*

8. The lack of pure light and pure air in mines tells seriously

upon the health of miners. "Fourcault affirms that where life is prolonged to the average term, the evil effects of the want of light are seen in the stunted forms and general deterioration of the human race. It appears that the inhabitants of the arondissement of Chimay, in Belgium, 3000 in number, are engaged partly as coal miners, and partly as field-laborers. The latter are robust and readily supply their proper number of recruits to the army; while among the miners it is in most years impossible to find a man who is not ineligible from bodily deformity or arrest of physical development." *Forbes Winslow's Influence of Light.*

9. Dr. Andrew Winter in the *Pall Mall Gazette,* London, says: —"When the St. Martin's national school, leading out of Endell street, was built some years ago, we noticed with pleasure that a play-ground was built at the top of the school, where light and air were plentiful. The necessity of light for young children is not half appreciated. Many of the affections of children and nearly all the cadaverous looks of those brought up in great cities, are ascribable to this deficiency of light and air. When we see the glass-rooms of the photographers in every street, high up on the top-most story, we grudge them their application to a mere personal vanity. Why should not our nurseries be constructed in the same manner? If mothers knew the value of light to the skin in childhood, especially to children of a scrofulous tendency, we should have plenty of these glass-house nurseries, where children may run about in a proper temperature, free of much of that clothing which at present seals up the skin —that great supplementary lung—to sunlight and oxygen."

10. "It is a well established fact that, as the effect of isolation from the stimulus of light, the fibrine, albumen and red blood-cells become diminished in quantity, and the serum, or watery portion of the vital fluid, augmented in volume, thus inducing a disease known to physicians and pathologists by the name of *lukæmia,* an affection in which white instead of red blood-cells are developed. This exclusion from the sun produces the sickly, flabby, pale, anæmic condition of the face, or ex-sanguined, ghost-like forms so often seen amongst those not freely exposed to air and light. The absence of these essential elements of health deteriorates by materially altering the physical composition of

the blood, thus seriously prostrating the vital strength, enfeebling the nervous energy, and ultimately inducing organic changes in the structure of the heart, brain and muscular tissue." *Dr. Forbes Winslow.*

XXI. When Sunlight is Injurious.

1. Very bright and hot sunlight is injurious and sometimes dangerous when allowed to fall directly on a sensitive or overheated brain, on inflamed, or over-sensitive eyes, etc. It is more especially apt to be dangerous to those who indulge in alcohol, opium and other cerebral stimulants, or to those who have large active brains and full flow of blood, especially of the red arterial kind. In such cases the tendency is to *sun-stroke*,* and the blue or violet principle is needed as counterbalancing agents.

2. The *symptoms of sun-stroke* are usually head-ache, vertigo, dimness of vision, nausea, often developing into coma, or even delirium and convulsions, ending in many cases in insanity, softening of the brain, or death.

3. For the *Prevention of Sun-stroke*, the following are hints. especially when there is tendency to a hot brain:—

Wear a light-colored, well-ventilated hat with blue lining.

Avoid meats and other heating foods. Eat a plenty of fruit.

Wet the hair on the temples and top of the head often, but not behind.

Ladies should avoid the use of large masses of hair.

If the hot brain pressure is felt coming on, dash cold water on the face and temples, or in the absence of that, clasp and squeeze both temples with the fingers to crowd the blood back, and rub the back-neck powerfully to draw the blood from the cerebrum.

Where especial danger is apprehended, wear a cool, wet bandage around the forehead and head.

4. For the *Cure of Sunstroke* the great object should be to cool off and draw away the mass of congested blood from the front brain. I will detail the process which I adopted in a some-

* The use of the term *Coup de Soleil*, so difficult to pronounce by English speaking tongues, or of any other foreign words unless a more exact meaning is to be conveyed thereby, smacks of pedantry. If we cannot manifest our learning otherwise than by employing useless words, we are weaklings, sure enough.

what remarkable case on Fourth Avenue, New York, a report of which was given in the N. Y. Daily Graphic, and I believe that most cases, not only of sun-stroke, but of apoplexy, if taken in time, could be cured in the same way, especially as I know of many other cases which have been treated on a similar plan.

This man was supposed to be dead or dying, by his distressed wife, when I was called in, and according to her account he had already lain nearly three hours in a state of coma, brought on by the intense heat. To make matters worse his friends had drawn him off into the darkest corner of the room, where was the least air, and they lacked even the discretion to loosen his shirt collar or any part of his clothing. Hastily loosening his clothing, I called for ice-water, meantime pounding him briskly over his back, legs, and feet, and making downward passes from his head. When the ice water came, I put a quantity of it over his face, forehead, temples, and top-head, but was especially careful not to put any on the cerebellum and back-neck, after the plan which is frequently adopted, as this, by its contracting character, would tend to deaden a great vitalizing center, and also to close the channels of egress for the blood in its movement from the front brain. The ice-water caused him to start slightly and show signs of life. But the great agency upon which I depended was a pail of as hot water as could be endured, which I poured from a dipper on the back of his neck and lower occiput, as he was turned on his stomach and held out from the lounge, being careful not to reach as high as the upper back-head. This soon started him into new life, he showed some slight convulsions, vomited, and then rose up, exclaiming, "all right!" and declaring that he was well. I told him that he had better avoid business for a day or two, but he chose not to, and from that time onward did not lose an hour. The same hot water treatment is also admirable for paralysis, apoplexy, brain-pressure, vertigo, etc.

XXII. Sleep-Producing Elements.

1. There is great danger of making a mistake, in the processes for inducing sleep from the fact that the philosophy of sleep is not generally understood. This will be found explained to some extent in chapter Tenth, VII, 1. Intense action of the vital ethers of the front brain causes mental activity and conse-

quently wakefulness. When these ethers are drawn off to other portions of the body, the front brain becomes quiescent and sleep is produced. The best condition for intellectual action and wakefulness is when there is a free and uninterrupted flow of pure and well oxydized blood, for such flow stimulates the activity of the mental ethers as they flow through the contiguous nerves, while the ethers that flow through the blood are also active. Such blood is also favorable to sleep in the time of sleep, as it causes a brisk action of forces in other parts of the body, which relieves the head. When, however, through impoverished or imperfect blood, or when from over-excitement of the cerebrum the front and upper brain become congested so as to blockade the free channels of these mental ethers, consciousness dies out, and what is called sleep (sometimes coma) ensues, but a very imperfect style of sleep it is, which serves but a poor purpose in building up the system. This condition is induced by opium and some other narcotics. From the following synopsis of the opinion of the London Lancet, it will be seen that even the old school of practice is beginning to repent of the use of one of their most common remedies :—

" Sleep produced by narcotics or so-called sedatives, is poisoned. Their use gives the persons employing them an attack of cerebral congestion, only differing in amount, not in kind, from the condition which naturally issues in death. There is grave reason to fear that the real nature of the operation by which these deleterious drugs, one and all, bring about the unconsciousness that burlesques natural sleep, is lost sight of, or wholly misunderstood, by those who have free recourse to poisons on the most frivolous pretences, or with none save the exigency of morbid habit. Great responsibility rests on medical practitioners, and nothing can atone for the neglect of obvious duty."

2. From the above it may be seen why opium, which has a considerable of the exciting principle of yellow and red, may induce sleep. Having a strong affinity for the brain, it at first excites that organ and gives animation of thought and feeling; when so much blood has been drawn there as to produce congestion, the sleepy feeling approaches. The reason why it tends to prevent diarrhœa, is that the heat of the bowels is drawn towards the brain.

3. While the blue, indigo and violet are naturally cooling and soothing to an excited brain and nervous system, and especially promotive of sleep, yet in cases of costiveness, the yellow light over the bowels, or substances charged with light through yellow chromo lenses (See IX of this chapter), often cause such action of the bowels as to call the excitement from the brain and produce sleep. In most cases, however, the violet and blue are the natural sleep-producing principles for an excitable or feverish brain. I would advise persons who are costive, and yet nervously excitable, to take yellow-charged water during the daytime and blue charged water on retiring. A warm hand on the back neck or lower spine, or a hot foot bath will assist in inducing sleep.

XXIII. Practical Instruments for Color-Healing.

1. Thus far we have seen an overwhelming array of facts to show the marvelous healing power of light and color as a new and blessed reality which is just dawning upon mankind, and it will now be well to consider briefly some of the instruments by means of which this power can best be utilized. Having endeavored thus to crystallize the different color potencies into a therapeutical *science*, it is now important also to gain some hints on chromo-therapeutical or chromopathic *art*.

2. *The Material through which Colors are transmitted*, is a matter of great importance. There have been so many thoughtless directions with reference to this subject, so many mere assertions without proof, and entirely contrary to established laws, that it is high time some definite standard was reached. General Pleasanton recommends the mazarine glass, and this is colored with cobalt. Dr. Pancoast, in his *Blue and Red Light*, says: "1. There is no special virtue in one blue pane of glass over any other of the same shade; cobalt blue is the best, and glass colored in the process of manufacture, is better than painted glass, because the pigment applied externally imparts more or less opacity to the glass. 2. There is no special advantage in any particular method of arranging the glass in any particular sort of frame; an ordinary sash placed upright in the window frame, is as good as any other frame in any other position. 3. The blue ray cannot be focalized—it refuses to be modified, or

changed, or concentrated by the most powerful lens," etc. Admiring these gentlemen for the interest they have taken in this admirable cause of light and color, I am sorry to have to differ totally from the above conclusions excepting in the matter of painted glass. *What is the use of colored glass excepting its power to transmit certain colors,* and why have not these gentlemen inquired into the colors which different kinds of glass transmit?

3. *Cobalt blue Glass,* is brilliant to look at, and multitudes have purchased foreign *Mazarine Blue* glass at high prices in order to gain what was supposed to be some mysterious potencies, although American manufacturers are now making it equally well. But this same cobalt glass through which people fondly suppose that they are gaining the cooling, soothing principle of blue almost solely, transmits nearly every color in the spectrum both visible and invisible, hot and cold. "The spectrum obtained under this glass," says Prof. Robt. Hunt, was perfect from the extreme limits of the most refrangible rays down to the yellow which was wanting. The green ray was diminished, forming merely a well defined line between the blue and the yellow rays. The orange and red rays were partially interrupted." "The extreme red (thermel) forms a well defined circular image." (Researches on Light.) Sir John Herschel also has shown how finely the very hottest invisible rays below the red, the thermel, are passed through cobalt glass. The real character of the cobalt color-transmissions, then, is as follows: while it transmits the blue, indigo and violet, and the fine rays far into the invisible trans-violet, it also transmits something in the hottest portion of the prismatic scale, including thermel, and part of the red and orange. It is quite unfit then for a hot, excitable brain, or for a very sensitive and over-nervous person, and is by no means the best for inflammatory conditions, although it would be excellent for persons with some degree of nervousness from its predominance of electrical colors, and also with some dormant conditions of bodily function, especially if still farther aided by white or orange light. Thus far I have never had a single patient who could endure the mazarine colors long upon the head, and one lady, the wife of General P., who let them fall upon an inflamed stomach, complained of their heating qualities.

Contrary to Dr. Pancoast's assertion, too, I find by experiment, that the blue light can be brought to a focus just as readily as red or yellow light, although of course it does not form so brilliant a focus as the more luminous colors, and moreover as to "the special advantage of any particular method of arranging the glass in any particular sort of frame," the testimony of Mrs. Proessel, already given, shows that special methods have special advantages, and I shall soon attempt to show just how these colors should be arranged in order to the finest physiological effect in describing the *Chromolume*, the *Chromo-Disc*, etc. But first of all it is important to know the exact chemical properties which are transmitted through different kinds of glass.

3. *Deep Blue Glass*, colored by *Cupro-diammonium-sulphate*, or, in the old nomenclature, the *cupro-sulphate of ammonia*, (N_2 H_6 Cu) SO_4, has a rich deep color, and is the true vehicle of the color electricities almost entirely unadulterated by the thermal rays, consequently it should stand at the head of all the colors for the general calming and cooling of the brain, nerves, or inflammatory sections. It "obliterates all the rays below the green ray, those above it permeating it freely." "The most refrangible or chemical rays well insulated." (Hunt.) So far as I know there is no glass in the market of exactly these ingredients, although I have been able to get my blue chromo-lens made with nearly these materials.

5. *Deep Iron Green.* The description of this and other styles of glass is condensed mainly from Hunt's "Researches on Light." Glass colored green with iron oxide admits the violet, blue, green and orange freely, and some yellow and red. Is scarcely surpassed for its cooling electric effects.

6. *Very brilliant Copper Green.* Admits violet, blue, a small amount of orange, a fair amount of yellow, and a full amount of green.

7. *Violet Glass* (Manganese). The yellow rays nearly wanting ; red shortened ; green fades into black shadow, and all the other rays blended in an intense oval patch of blue. The chemical action extends into the trans-violet.

8. *Red or Pink Glass* (Gold). Very beautiful. The spectrum becomes an oval spot of intense redness covering the visible thermal rays, embracing thermel, and extending to blue.

9. *Red-Orange* (Silver). All the more refrangible rays decidedly obliterated, and even the green somewhat shortened ; but in the place of the blue and violet rays there is some red. The yellow and orange are considerably reduced, the red standing out in great brilliancy, giving the glass the general character of red-orange.

10. *Pure Yellow* (Coloring matter Carbon). Is lacking in the violet and indigo rays ; strong orange and yellow-green reduced—a weak blue—acts far up in the fine trans-violet rays.

11. *Yellow by Iron.* Transmits thermel, some red, considerable orange, strong yellow, small amount of decided green rays, some indigo. Gives the fine tonic effect of *refined iron.* I have given the colors as they are usually named. What is commonly called yellow is really nearer a yellow-orange in many cases. Numerous other kinds of colored glass are used, but space is wanting here, and these are the leading qualities.

Colored Solutions.

12. *Thermel and red. Solution of Carmine in supersulphate of Ammonia.* Transmits thermel, red and lower half of orange.

13. *Yellow. A saturated solution of Bichromate of Potash.* Beautifully transparent ; red and yellow.

14. *Green. Chlorate of Iron and Copper.* Highly transparent, transmitting blue, green, yellow and orange.

15. *Fluorescence. One part of the Sulphate of Quinine to* 200 *parts of water* on a plate glass trough transmits the whole of the visible spectrum, and develops a "celestial blue" in the invisible trans-violet portion over a space about equal to the visible spectrum. When the solution is made stronger the violet is more or less cut off. Other fluorescent materials have been spoken of elsewhere.

16. *Blue. Cupro-Sulphate of Ammonia,* described in No. 4.

17. *Other solutions* can be made of material much the same as those given in the different colored glass, with a spectrum which must be similar. Very many other combinations, both in glass and in solutions, are practicable.

XXIV. Heat Transmitted by Colored Substances.

1. The following table, prepared by Robt. Hunt, shows that the greatest heat is transmitted not by red or ruby glass, as might be supposed from the well known heat of red, but by the orange glass which transmits not only the red and thermel, but something of the electrical blue, thus adding another fact in proof of the principle which General Pleasanton's discovery seemed to verify, namely, that a small amount of electrical rays added to a mass of warm rays, causes a greater heat that the warm rays alone. Next to the orange glass, a transparent substance transmitting all the rays gives the most warmth, then the yellow glass, then the red, while the green and some grades of blue glass are coldest in their transmissions, though cobalt blue is warmer than "*brown-red,*"—or more properly speaking very red brown.

Colors.	Colors transmitted.	Heat.
Ruby (gold).	Red and thermel.	87° F.
Brown-Red.	Red, orange and portion of thermel.	83°.
Yellow. .	Red, orange, yellow, green and blue.	88°.
Cobalt Blue.	Violet, indigo, blue, some green, and some orange, red and thermel	84°.
Orange. .	Little blue, green, yellow, orange, red and thermel	104°
Deep Green.	Orange, yellow, green and blue .	74°
Clear glass (with a little water), all the rays . .		89°

2. Without the water in the last case, the heat would have been somewhat greater, though still less than that transmitted by the orange glass. Other grades of glass, to be hereafter experimented upon, will probably modify this table somewhat. The foregoing facts show that a substance may appear to transmit yellow, orange, etc., and nothing else, judging by its main effect when the light shines through it, whereas the spectrum will reveal several other colors which are also transmitted. Such facts do not signify that the pure red and thermel rays of light are not the warmest, nor that the blue, indigo and violet are not in themselves the coldest. It is true, however, that any careful

observer can see, in what is usually called yellow glass, tints of orange ; in other words, its real color as it appears even to the unaided eye is yellow-orange. The coldest rays transmitted, as given in this table, are in connection with deep green, although of course a blue or violet equally deep must be still colder.

XXV. The Chromolume.

1. Having ascertained the color potencies which are transmitted through various hues of glass, as well as of fluids, we are now prepared to inquire how they should be combined in order best to harmonize with physiological law in the cure of human ailments.

2. *The Head and Brain.* In the first place the head being the positive battery of the whole system, and the brain having seven or eight times the amount of blood in proportion to its size that is averaged in other parts of the body, together with a great mass of nerve matter, its general tendency is to be especially warm and sensitive, consequently we need for its purpose the nerve-and-blood soothing colors, such as blue, indigo and violet, and the absence of the warm colors. For this reason panes of glass colored by the cupro-sulphate of ammonia already described (XXII, 4), would be most admirable for this purpose, especially as it gives free passage to the violet, indigo and blue rays, and almost entirely excludes the thermel, red, orange and yellow. The Mazarine blue glass, although handsome, is more heating as we have seen than other grades of blue, and therefore poorly adapted to the brain. Theoretically, the violet ray being the most refined and cooling, would naturally be the best for the head, but there is no violet glass known that can give us the pure violet without a goodly share of red, and this interferes with the best effect for most brains, for which reason the blue and indigo shades are on the whole the best. We will need, then, 12 or 15 inches in depth of the cooling style of blue glass to cover the head well, while its horizontal width may be about 15 inches. This we will form into a graceful ogee curve at the top, and for the sake of developing its power best will place a border of red orange, 2 or 3 inches in width, over its top and sides, to arouse its best affinitive action and give beauty of effect.

3. *The Neck and Thorax.* Joining immediately on to the

last named glass, we shall need another piece for the neck and upper thorax, reaching considerably over the lungs and heart. This like the other should be cooling in its nature, being over a somewhat excitable region, and yet can well tolerate a certain amount of heat, so under ordinary circumstances the mazarine blue glass, colored with cobalt, will probably be the very best which could be employed for that region. We will need about six inches of this and will border it with red, colored with gold.

4. *The Hypochondrium.* We come now to the upper bowels, including the liver, stomach, spleen, duodenum, etc., and constituting the central region of *digestion.* What color is most needed for good digestion? Two important substances are used in digesting food, gastric juice and saliva. The gastric juice being an acid, and consequently electrical, would have its action increased by the thermal colors, such as red and yellow, and the same colors would also stimulate the blood, muscles and nerves of the stomach, while the saliva, having the alkaline or thermal principle predominant, would have its chemical action increased by the blue or violet, which would also tend to counteract too much of the inflammatory action of the red. A medium purple glass transmits these principles and thus becomes par excellence the color for regulating digestion. Six inches of this will answer, and a border of yellow or greenish yellow, especially the canary yellow of uranium, will form its chemical affinity.

5. *The Umbilical Region.* The bowels are aroused into animation by the yellow color more especially, as has been abundantly shown, and a small strip of yellow glass three inches in depth, bordered by its affinitive violet, will be sufficient.

6. *The Hypogastrium and Loins.* For the loins and lower viscera, a green glass will have a fine tonic effect, and will be very soothing to any inflammatory conditions, such as cystitis, uterine or ovarian irritation, etc. Nearly every variety of green glass transmits the orange, yellow, green and blue rays. The yellow and orange will animate the nerves, while the blue will have a cooling effect and tend to constrict and draw up relaxed muscles. If the parts are dormant, yellow-green would be preferable—if inflamed and over-active, blue-green. A border glass of dark red will be nearly a chemical affinity.

7. *Lower Limbs.* For the rest of the way covering the limbs

and lower extremities, the warmest colors are most desirable, especially as these parts are farthest from the vital centres. Having ascertained that the warmest effect comes through the orange or red-orange glass, this will be the most proper material, while the mazarine blue and the cooler blue will be excellent affinitive colors for the border on each side. About 15 inches of this will be sufficient, as the patient should sit or recline while receiving the colors.

8. The whole of this combination enclosed in a walnut frame with metallic frame work inside for the different colors, I have termed the CHROMOLUME,* which means literally *color-light.* Its colors being arranged very much on the law of harmonic contrast, as well as according to the principles of chemical affinity, it constitutes one of the most beautiful ornaments imaginable for a drawing-room, or bed-room window, and certainly one of the best of all instruments for vitalizing, healing and toning up the human system.

XXVI. THE USE OF THE CHROMOLUME IN HEALING.

1. *Position of the Instrument.* The lower end may rest upon the lower ledge of a window, while a cord is attached to the upper end, and being passed through an improvised loop at the top of the window may come down and be held by the hand, or wound around some hook or nail at the side of the window. In this way the upper end of the chromolume may be allowed to hang some distance from the window or parallel to the window to make the light strike in the right place, or the whole instrument may be drawn up further towards the top as circumstances may require. An invalid chair in which a person may be placed at different angles would be desirable, but an ordinary lounge or rocking chair will answer.

2. *Treatment of Head.* A majority of persons who are in feeble health, or who use the brain too intensely, have the head too warm, and the liver, stomach, and bowels too dormant, and the

* From χρῶμα *color*, and *lumen*, light. Some may object to the union of a Greek and Latin root in the same word, but as we may thus gain so euphonious and expressive a term by the means, it seems quite whimsical to raise this objection. What are these two old dead languages good for except to be resurrected for use in the living present, in all kinds of combinations which are most concise and musical?

arrangement of the colored glass in the chromolume as already described, is just suited to such conditions. In case the brain



Fig. 169. The Chromolume.*

1. Light Yellow colored with silver for the disc, 3 inches in diameter.
2,2. Light colored violet, (Manganese.)
3,3. Red-Orange (Silver), 17 in. long.
4. The cool grade of blue 14 in. deep by 16 broad, colored by cupro-sulphate of ammonia, or similar materials.
5. Mazarine Blue, 6 × 16 in., colored with cobalt.
6,6. Ruby red on the left and gold-red on the right, 2½ × 6 in.
7. Purple, 6 × 16 in., Manganese and gold.
8,8. Light Greenish Yellow, 2½ × 6 in., colored with uranium oxide.
9. Yellow, 3 × 16 in., colored with iron or other metal.
10,10. Deep Violet, 2½ × 3 in., manganese.
11. Green, 6 × 16 in.
12,12. Dark Red, 2½ × 6 in.
13. Orange, 16½ × 16 in.
14,14. Light Violet, 2½ × 16 in., manganese, etc.
15. Red-Orange, 2½ × 16 in., silver.
16,16. Blue, 2½ × 2½ in.

* I have designed two sizes of the Chromolume, both prepared after the above design, the glass part of the larger being 57 by 21 inches, the inside column being 16 inches, and the borders 2½ inches each in width, while the smaller is 53 by 18 inches, the central column being 14 inches, and the borders 2 inches in width. The larger can be furnished at $10, the smaller at $9, and an extra charge of $1 for boxing when they are to be shipped. What is called the crystalline style of glass, consisting of foliations over the whole surface, and being more beautiful and somewhat more effective than the glass in common use, will cost one quarter more when the border alone is supplied with it, and one half more when the whole frame is supplied with it. Those wishing a chromolume can address: BABBITT & CO., *Science Hall*, 141 *8th St.* (Near Broadway), *New York*. In very special cases of disease, by giving a brief and clear explanation of the symptoms to be treated, the glass in the instrument will be changed to suit conditions as far as possible. The glass for a chromolume may not always be found of exactly the grade or character of what is named above, but some of the choicest and richest grades that can be found will be provided. These instruments will be furnished only to order.

The CHROMO-DISC can be furnished, including five colors of crystalline glass, a lens 2 inches in diameter to concentrate the rays, for $5. The price of the crystalline glass is $1 per square foot.

and nerves, however, are in the negative condition which induces facial neuralgia and general coldness, the instrument should be raised a little, so that the face and ears at least should come in the range of the mazarine glass.

3. *Treatment on the Skin.* Decided benefit can be received from sitting in the light of the chromolume with the ordinary clothes on, much more benefit by sitting in a white garment or covered by a sheet, and still more benefit by allowing the rays to fall directly upon the skin. In this last case a person takes a full air bath as well as a color bath. With dark clothes on, the light is degraded into mere heat, although of a fine quality.

4. *Treatment of the Back.* After using the light in front for some time, the patient should turn over and let it strike on the back in much the same manner as on the front. If the back of the neck and lower spine and hips are especially cold, the patient should slip down farther into the warm rays, the upper spine and occiput coming under the mazarine glass, and the lower spine coming under the orange and green glass combined. By animating the occiput, and the cervical and brachial plexuses of nerves, reaching as low as the shoulders, a life-giving power is communicated to the arms, lungs, motor nerves, etc., which will prevent, or tend to cure, rheumatic, paralytic, or inflammatory conditions of those parts, while by thoroughly animating the lumbar and sacral plexuses of the lower spine, the lower viscera and limbs will receive a new life, and sciatica, lumbago, rheumatism, gout, paralysis, etc., be relieved. In female or other difficulties which cause the small of the back to be hot and weak, that portion should be under the green glass, and the hips, which are apt to be cold, under the orange. The green, which is one of the most cooling of all glasses will thus tone up the back, while the orange glass, by its great heat, will call away the warmth from above, and animate those nerves that give warmth to limbs and feet, which in such cases are generally too cold.

5. *White Light with the Colored.* In most baths of the chromolume light, it would be well for a part of the time *to have a portion of the body under the direct sunlight*, keeping the head in most cases in the blue light, or if even that is too strong for

a very sensitive brain, the light can be shut off altogether from the head, by hanging cloth or paper over the upper part of the instrument. If a correct anti-thermal blue glass can be found, such a precaution will not be necessary.

6. *If the bowels are habitually too free or inflamed*, the narrow strip of yellow glass can be covered up, and the body slipped down farther under the green, the tendency of which is cooling, anti-inflammatory, and constricting.

7. *For sluggish action of the kidneys*, tendency to dropsical affections, Bright's disease, etc., it would be well to have the junction of the yellow and purple glass come just above the small of the back, remembering also to have the white light fall on that portion for a time each day, especially the white and colored light combined.

8. *For Feverish and Irregular Condition of the Sexual System*, the green glass light should come over the small of the back and lower spine, the orange commencing at the lower part of the hips. This rule is of great importance, and will tend to save the patient from the fearful wreck that overtakes vast multitudes of mankind, and from a condition which, if not arrested in time, will baffle the power of all drugs to heal. It should be pursued perseveringly, days, weeks and months if necessary, for there is a quiet, deep-reaching and marvelous power in well regulated light to heal all such difficulties, as well as to build up exhausted nervous systems generally.

9. *Artificial light* may be used to fine advantage with the chromolume, especially if the lamp or gas-burner is directly behind the blue or green shades of glass. Such lights having a larger relative amount of carbon than sun-light, the yellow and orange principles are more active, which fact explains the cause of their being more exciting to the eyes and nervous system than the light of day, causing inflammation of the eyes (ophthalmia), dimness of vision (amaurosis), etc. Blue and violet light constitutes a beautiful balancing power for such conditions. (See Chapter on Vision.) The great advantage of being able to use artificial light, especially in a country like England, in which direct sunlight in winter is very scarce, and also during the darker portions of our own year, must be apparent to all. Artificial light has much the same character as sunlight, with the excep-

tion that it is feebler, less white, and more irritating, but when it is purified by being strained through glass, and its yellowish and reddish character offset by a certain amount of the blue and violet element, it can be made very valuable. The electric light has great power and purity. Although the light for general purposes may well be placed directly back of the blue glass, yet for special conditions it must be changed; thus, for head-ache, sleeplessness, etc., place it back of the upper blue; for sore throat, and most lung difficulties, place it back of the mazarine blue; for indigestion, back of the purple; for costiveness, back of the yellow; for uterine or ovarian inflammation, back of the green, etc.

10. *A convex Lens for concentrating the rays*, hung behind any particular kind of glass, according to the part of the body which needs most power, greatly intensifies and hastens the action of the light, but this should not generally be done over the brain, or over the heart in case it is subject to palpitation.

XXVII. The Chromo-Disc.

1. Another instrument which I have devised, and which I call the Chromo-Disc, although not possessing the resplendent array of colors of the chromolume, and not, like that instrument, having the power to cover the whole system at a time, has some advantages as follows:

It concentrates the light at any portion of the body with several times its ordinary intensity.

It can be moved about with the greatest ease to any desired position.

It is admirably adapted to artificial lights, as it can be placed on a table, bureau or chair, and turned to any point of the body. It works equally well with sunlight.

It is supplied with the blue, the yellow, the red, the purple, and the opalescent white glass, which last admits all the rays in a softened refined form. The different styles of colored glass are all of the beautiful kind with foliated work, called crystalline glass.

It is supplied with a small lens two inches in diameter, so that in the case of tumors, mother's marks, or very dormant conditions, it may concentrate the rays with still greater power, or the

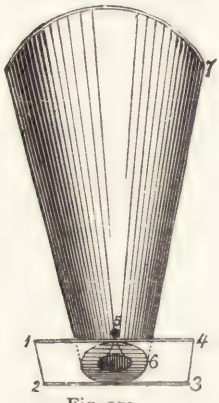


Fig. 170.
The Chromo-Disc.

lens may be used separately at times. Fig. 170 represents the Chromo-Disc. Diameter at the smaller end about 5 inches, at the larger end 15 inches, length 19 or 20 inches from 6 to 7; material, tin with a Japan varnish on the outside; 1, 2, 3, 4, is a frame about 5 by 12 inches, in which the glass is inserted so as to cover the small end of the disc, and will hold a white and colored pane simultaneously when desired; 5, is an aperture through which the lens can be inserted when needed. It concentrates the light with about 4 or more times the ordinary intensity if kept bright. The portion of the body upon which the light falls should be as near the small end as possible to get the greatest power. The instrument complete with the five kinds of crystalline and opalescent glass and the lens can be furnished at $5. It can be held in the hands with the large end as perpendicularly as possible to the sunlight, or can be laid on a table and its ends raised by means of books or other objects so as to get it in exact range with the sun's rays or with artificial light. Under the hot rays of summer, shining directly into the disc without the intervening of windows, the skin can be rubricated in from 30 to 100 seconds on some tender portions of the body, while in a still longer time blisters can be drawn, although the latter style of violence should not be practiced on ordinary occasions. If, however, it should be deemed necessary to vesicate the skin in severe cases, the vesication caused by sunlight is much less injurious than that caused by the ruder drug escharotics. Vesication can be caused the most readily through the yellow or red glass, or without any glass at all. The chromo lens, however, is superior to the disc for purposes of vesication or for concentration of power.

XXVIII. General Healing with the Chromo-Disc.

1. *For Nervous Excitability, hot or Inflammatory Conditions, Fevers, Acute pains*, etc., the BLUE is the proper glass to use, as this admits the violet, indigo and blue, and a portion of the fine

trans-violet. Where the condition is somewhat dormant, and yet nervous, slip the blue glass along and let in some of the white light, at least a part of the time.

2. *For arousing the arterial blood, warming cold extremities*, etc., the RED glass is excellent, but should also have more or less of the YELLOW glass which really transmits a greater variety of warm rays than the red, as we have seen.

3. *For arousing nervous action, warming up and thawing out*, so to speak, *hard negative inflammations, and vitalizing a cold, chronic condition*, the YELLOW glass is best.

4. *For animating the venous blood, stimulating the stomach, liver, spleen*, etc., the PURPLE glass is best, although the yellow is very fine for the liver also.

5. In many of the above cases, the glass may be moved along a part or the whole of the time, so that the white rays may combine more or less with the colored ray, and thus add power and variety of effect. In case the direct white light is too strong, and especially in case of gas-light or candle light where there is no glass to strain the light of its coarser elements, the white glass can be inserted by the side of the colored glass.

6. For very sensitive places like the brain, the blue should be used, and the disc should be held six inches or more from the head so as to give a soft diffused light.

XXIX. HINTS FOR TREATING SPECIAL DISEASES WITH THE CHROMO-DISC.

1. *Diseases of the Brain and Nervous System.**

For a *Very Hot Brain*, blue glass only. A wet bandage over front and side brain in emergencies.

Congestion of the Brain. Blue over the front brain, blue and white or purple and white, over the occiput (back-head) and

* In presenting this list I do not, by any means, give the only method that is useful, but the one that is the most directly indicated on general principles. Much must be determined from the patient's feelings and symptoms. It should always be remembered, however, that in dormant or chronic conditions, the thorough rousing treatment, which is required under any true method of treatment, must often bring up old symptoms, and in some cases cause uneasiness for days or even weeks before relief may come. In my explanations I shall aim to avoid technical terms and use as simple language as possible to be brief. By the term white, I mean white glass.

and cervix (back-neck). (Feet in hot water.) If the cervix is cold, use the yellow awhile.

Softening of the Brain.—Blue and white over the front brain, and at times blue and white or even yellow over the occiput.

Hydrocephalus (*Water on the Brain*).—Yellow and white over the occiput, also blue and white in front.

Facial Neuralgia.—Blue over temples, ears and face.

Heat of Spinal Column.—Blue, or blue and a little white.

Apoplexy.—Blue on front brain; (hot water over the lower occiput and cervix, as in sunstroke, XXI, 4.)

Paralysis.—Yellow and white over lower occiput, also over upper and lower spine, purple over pit of stomach; yellow over bowels. When the spine is warm use blue.

Convulsions.—Blue over pit of stomach, as well as over the occiput, spine, etc.

Hysteria.—Blue over the head; also blue, or blue and white over the womb, small of back and pit of stomach.

Sciatica.—Blue and white over lower spine.

2. *Diseases of the Respiratory Organs.*

Pneumonia.—Blue over the lungs, blue and white over the cervix * and lower occiput.

Pleurisy.—Blue and white where the pain is acute.

Hemorrhage of lungs.—Blue. (Feet in hot water.)

Consumption—Tubercular and Chronic.—Yellow and white over the lungs, also over the cervix. Occasionally use purple and white, or blue and white when too much heat exists, and when sleeplessness and hot brain occurs use blue on the head.

Bronchitis.—Blue and white over upper lungs, alternating at times with yellow and white; the same over the cervix.

Aphonia (*loss of Voice*).—Yellow and white over the throat and cervix.

Croup.—Yellow and white alternating with blue and white over throat and cervix.

Sore Throat.—Blue in front, yellow on the cervix.

3. *Affections of the Organs of Circulation.*

Palpitation of the Heart.—Blue over the heart, several

* It should be remembered that some nerves of the cervix connect directly with the lungs.

inches off; also purple over the digestive organs and yellow over bowels.

Fatty Degeneration of the Heart, or other dormant conditions; red and white, or yellow and white. If the excitement becomes too great, use the blue.

Goitres and other *dormant Tumors* should have a lens and strong sunlight, or the red or yellow glass. Positive or hot inflammations should have the blue. Great cures can be thus wrought.

4. *Diseases of the Skin.*

Purpura (purple spots).—Yellow—sometimes the purple.

Nævus (mother-mark).—Has often been scattered by Mr. Augustus Barnes by sunlight focalized on the spot by a lens. I would recommend also some use of the blue glass to counterbalance the red principle, and at times the use of the red or yellow to scatter the same.

Erysipelas Red Pimples, Rash, and hot conditions of the skin generally indicate the counterbalancing blue principle, excepting probably such diseases as the *Small Pox* and other *Exanthemata*, which may be treated as in the next paragraph. Scabies (Itch) and other diseases in which parasites occur, need the blue, which, as will be seen in the next chapter, often destroys animalcules.*

Pustules, White or *Watery Pimples*, etc., should be treated, I think, with an alternation of yellow and blue glass, the former to animate and scatter the dead conditions, the latter to cool off the heated parts.

In diseases of the skin it is very important, of course, to attend to diet and have the liver, blood, bowels, etc., in good working order.

5. *Zymotic Diseases* (*Epidemic, Contagious, Endemic*).

Eruptive Fevers, or *Exanthems*, such as *Small Pox, Scarlet*

* In such diseases as well as Erysipelas and overheated conditions, I have often afforded the patient a remarkable relief by having him bathe with carbolic acid, a tea-spoonful of the acid being used to a quart or more of water. The carbolic acid seems to destroy the parasites developed by over-heat and excess of the alkaline principle, while pearlash, occasionally used, will destroy the excess of animalcules develcped by too much acidity. A teaspoonful of pearlash can be used with a quart or three pints of water. All systems abound in animalcules, but when any part becomes excessive in its action, or out of balance, it is liable to have an excess of them.

Fever, Measles, etc., should, I think, have the virus well brought outward by the stimulating character of red or yellow. After this is well developed, the cooler principle of purple, then blue and white, and then blue alone can be applied to reduce the fever.

Whooping Cough.—Yellow and white, also blue and white at times upon the throat.

Diphtheria.—Blue over the throat and pit of stomach, and yellow and white at times on the cervix. Start the bowels into action in this and the other zymotic diseases by the yellow glass over them. At times rouse the throat with yellow.

Intermittent Fever, or Ague and Fever.—In this disease the negative condition of the system seems first to draw the heat from the skin to the internal organs, leaving the surface where sensation is most acute, in a chilled condition, after which the interior organs, becoming surcharged with heat, react and send a thermal wave to the skin, thus giving the burning effect of fever. Thus while the patient feels cold he is internally hot, and *vice versa*. Now as the *solar plexus*, stomach, etc., which are central portions of the visceral system, must be overheated during the chill, my plan would be to concentrate the blue light directly on that point, especially the pit of the stomach, where it can penetrate very deeply and establish an equilibrium, while on the other hand, during the fever, the same portion being too cold could be animated by the yellow glass, which should also extend somewhat over the bowels, as they are known to be torpid during the hot stage. On the same plan the drinking of very hot water during the fever, and of cold water (say lemonade) during the chill, would hasten the winding up of the disease very materially. When the head aches use blue glass over it, especially during the fever, as it will both soothe the head-ache and check the fever.

In *Atonic Fevers* in which the forces are negative, flowing inward too much, such as *Typhoid, Ship, Jail, Camp and Yellow Fevers*, the blue glass is most important for the head, perhaps the blue and white for the cervix, the purple somewhat over the stomach and liver, but the blue over the bowels if the diarrhœa is bad.

In *Entonic Fevers*, in which the forces are positive and inflammatory, flowing outward, exemplified by *Bilious Fever, Typhus Fever*, etc., bring the blue to bear strongly upon the head,

especially the temporal and frontal region, the yellow upon the bowels, etc., as symptoms may indicate.

6. *Diatheses.*

Inflammatory Rheumatism, needs of course the blue glass over the inflamed parts, but especially on the upper and lower spine, the upper spine including the lower occiput, the cervix and the brachial plexus having a direct power over the whole system, and especially over the arms and hands, while the lower spine including the lumbar and sacral plexuses, rules the legs and feet. Open the bowels with the yellow, tone up the stomach and liver with the purple, use blue sometimes over the heart, etc.

Chronic Rheumatism, in which the parts have become dormant and hard, and crooked by long standing, need the yellow over the upper and lower spine, as well as over the parts directly affected; sometimes the red may be used, and if the excitement becomes too great, the blue and white may be used, or blue alone.

Gout should be treated on the same general principles as rheumatism, somewhat more attention being given to the kidneys, which may be quickened with yellow, while a nauseated or agitated stomach should be soothed with the blue, and hot painful toes with the same.

Scrofula, as we have already seen, is caused or promoted greatly by a want of light, as well as of pure air, to vitalize the lungs. The stomach should be well toned up by purple, the liver by purple, and sometimes yellow, the bowels by the yellow unless they are irritated and too free, the lungs perhaps by blue and white and a careful diet used, consisting much of vegetables, cereals and fruits, rather than fatty and heating substances. By all these instrumentalities the blood is gradually made pure and the system enabled to eject its morbid matter.

Goitres, and other hard negative conditions especially require the yellow, the red being sometimes substituted, while a lens to concentrate the rays intensely will make still quicker work with it.

Nasal Catarrh, having such close connection with the brain, would perhaps be more safely treated with blue and white than with yellow light, and a sensitive brain cannot endure even this more than five or ten minutes at a time when the catarrh is bad.

7. *Diseases of Stomach, Liver, Bowels, Kidneys, Uterus, etc.*

Gastritis, Nausea, and other *irritated* or *inflamed conditions*

of the stomach, indicate the use of blue; very dormant conditions can have the yellow, but purple is best in most cases for stomach and liver.

Constipation: yellow over the whole bowels, especially the left and lower portion and briefly over the liver and stomach. Ten to twenty minutes will suffice with the disc.

Diarrhœa: Blue over the bowels, and briefly over the liver and pit of stomach.

Worms: purple over the stomach, also yellow over the stomach and bowels.

Cholera Infantum, or *Summer Complaint:* blue over the bowels and spine, and sometimes over the head and stomach. This will be found very effective. Even sunlight on the whole body would be excellent.

For the Liver in the case of a dormant or sluggish action, use the purple and yellow alternately just over and below the ribs.

For Inflammation of the liver (*Hepatitis*), use the blue.

For *Dormant Kidneys*, as in *Bright's Disease*, etc., use the yellow and red alternately, sometimes inserting the white, just above the small of the back, but if the small of the back itself is hot, use the blue. When the kidneys are irritated or evidently inflamed, use the blue, or blue and white. Treat other parts of the system as symptoms indicate.

Diabetes: I would recommend yellow, or yellow and white over the kidneys, liver and lungs, blue and white for the lower bowels, while the brain, bowels, etc., are to be regulated according to the symptoms. When the region of the kidneys seems over-excited or warm, use the blue. This disease is considered incurable by drugs, but occasionally full baths of sunlight over the whole body, with bathing, manipulation, etc., to start the skin, correct diet, together with the above treatment, will be powerful to heal even this disease, from what I have learned.

Inflammation of the Bladder (*Cystitis*). Blue over the hypogastrium, yellow over the lower spine, etc. In Chronic Cystitis, however, yellow in front may sometimes be used.

Uteri Lapsus (*Falling of the Womb*). Blue and white over the hypogastrium, also over the small of the back. Make upward passes over the lower bowels.

Inflammation of the Ovaries: blue.

Deficient Menstruation: alternation of yellow and red over the hypogastrium, breast, and lower spine.

Excessive Menstruation: blue over the hypogastrium and small of back. Tone up the liver and digestion.

Hemorrhages, Burns, Wounds, etc.: blue.

8. *General Suggestions in Healing.*

While treating local diseases, the whole system should be toned up and perfected so that a disease may remain cured. Among the leading things to be done is to see that the bowels move freely and properly, to have the blood well vitalized by purple over the liver, stomach, and lungs, or when especially inactive, by yellow over the same, and to have a due amount of the out-of-door sunlight, pure air, and nourishing but simple food. Wonderful as are the healing properties of light and color, so gentle, so penetrating, so enduring in their effects, and often so potent when coarser agencies are worthless, we must not be so narrow-minded as to consider it a panacea for all ills, and when we commence using it deem it unnecessary to attend to bathing, manipulation, friction, open air exercise, food which is heating or cooling, or demulcent, or laxative, according to conditions, proper sleep or other important considerations. While I have endeavored to make the general principles of chromatic healing so simple that private individuals may accomplish wonders by themselves, yet such is the complicated nature of disease, that a physician will be necessary to direct the use of the different kinds of glass in many cases, but this physician, however, should be familiar with the foregoing principles of Chromo-Chemistry and Chromo Therapeutics, either from his own investigations or from the study of this work. It is the intention of the Author to write a work on "Human Development, Including the Philosophy of Cure and the Upbuilding of Man by Nature's Diviner Methods," in which the aim shall be to present many new, practical and simple plans for developing both the mind and body as concomitants to light and color, and also to crystallize into a science, as far as may be, the subjects of therapeutics and psychophysics.

The use of colored glass by itself can be used on the same principles as the foregoing which are pointed out for the chromodisc, only of course it will require a longer time.

XXX. The Chromo Lens.

1. Taken all in all, however, there is an instrument which is cheaper, more convenient to handle, and exerts greater power in a short time than perhaps any other style of healing instrument which has thus far been invented, and that is the Chromo-Lens,



Fig. 171. The Chromo-Lens, one fourth of the actual size.

fig. 171. This I have had made of a pure crystal grade of glass, of three different colors, namely: the blue, of a character greatly superior to the mazarine blue in its exclusively soothing and electrical effects; the yellow-orange or amber-colored; and the transparent.

2. A remarkable fact with reference to these double convex

lenses is that they are hollow, the whole lens being five and a half inches in diameter, and one and a half inches through at the thickest point in the middle. Their capacity is about eight ounces, or half a pint.

3. Another remarkable thing about these lenses is that they are generally intended to be used only when filled with a liquid. This liquid may be water, and when thus filled, the more transparent lenses will sometimes ignite paper when placed in the direct light of the sun, 7 to 11 inches from the object, and of course would rubricate the skin in a few seconds if thus held, or vesicate it in a few seconds more.

4. The third remarkable thing about them is, that the substances placed within the colored lenses, and charged by the sunlight become medicated with an exquisite principle which is more gentle, enduring and far reaching in its effect than ordinary drugs. The simplest substance to charge thus is water, a dose of which may consist of from one or two teaspoonfuls to as many tablespoonfuls.

5. Two very distinct styles of power are developed by the aid of the lenses, 1st, by concentrating a certain color upon any desired portion of the body by holding the lens of that color in the sunlight; and 2dly, by charging the water with a therapeutical quality in harmony with that of the colored light itself for taking internally.

6. The water will become more or less charged in a few minutes of good sunlight, but I usually hang my lens in the window and let the sun constantly rest upon it, although in quite hot summer weather, the water should be changed for fresh water every two to four days, especially that in the yellow-orange lens. The handle, of course, should be kept on, as it consists of a stopper as well as a handle, and protects from the full sunlight as well as from impurities. This handle is composed of a handsome nickel-plated material which when screwed on brings the glass against a layer of cork so that the metal itself does not come in contact with the enclosed liquid.

7. Some *solutions* for the *Transparent Lens* are as follows, which I give without trying to astonish the reader with Latin terms or mysterious hieroglyphics difficult to be written, feeling confident that *pure water* would be just as effective if called by

its English name as if called *aqua pura*, that one drop would be just as much if written 1 *drop*, as if written 1 *gutta*, or 1 *minimum*, and that it would be just as accurately prepared if I should say *mix*, as if I should say *misce, misce cum aqua*, etc:

Solution for RED or slightly RED ORANGE :—

Sodium Salicylate. 2 grains
Tincture of iron. 4 drops.
Mix and fill the lens with water.

This is admirable for all cold and dormant conditions, being warming to the blood and animating to the nerves. It would be excellent for deficient menstruation if held over the lower viscera, more or less rousing to the bowels, and suited to dormant kidneys when held just above small of back.

Solution for BLUE :—

Cupro-diammonium sulphate. . . 20 to 40 grains.
Tartaric acid. 5 grains.
Mix and fill the lens with water.

If it is desired that a few of the warming rays should be transmitted through the lens, 20 drops of the sulphate would suffice, but 40 drops would make it more suitable for use over the brain or for an excitable nervous system. 25 or more drops of Ammonia would add depth to the blue. Another solution for the blue which will admit more red rays than the above is as follows :—

Solution of INDIGO. 25 drops.
Fill lens with water and filter if necessary.

A FLUORESCENT MIXTURE.

The following mixture which is more or less transparent to all the rays, being fluorescent, is remarkably attractive of the exquisite trans-violet forces :

Quinine Sulphate. 20 grains.
Dilute Sulphuric acid to dissolve it. . 20 drops.

For nervous persons soften with 10 grains Cupro-Sulphate of Ammonia, to give blue effect.

As the sunlight partakes more or less of the nature of that which it passes through, it must carry the effects of the quinine and sulphur of this mixture into the system receiving it, and thus have a refined tonic character, just as the first solution

named above carries the effect of iron, sodium, carbon, hydrogen and oxygen, and is exceedingly animating.

Solution for YELLOW-ORANGE :—

Potassium bichromate. 20 to 30 grains.

Mix with the 8 oz. of water and filter.

Laxative, and animating to bowels and nerves generally.

8. The *Colored Lenses,* however, have a special value over the transparent ones, inasmuch as they are always *charged* with a beautiful, deep color and require only water within, which of itself becomes exquisitely medicated for taking internally when desired. Although the solutions which are yellow-orange and red may be used with much effect in connection with artificial light, the others need the more electrical light of the sun, which is proportionally less potent in the thermal colors, for which reason on cloudy days, or at night, they cannot so well be used. If we put water, however, in the real chromo-lenses, it becomes charged while the sun is shining, so as to retain much of its power for days or even weeks, and can be used at any time internally. This is a great advantage.

9. *Sugar of Milk,* of the granulated kind which will *flow* easily in and out of the lenses, is an admirable neutral substance, which when put into these lenses will store up an immense amount of medicinal power, enough in fact to make hundreds of doses at a time. These may be kept strongly charged by letting them hang up against a window, or even by letting them occasionally come into the sun. The only trouble with sugar of milk is, that the lens containing it cannot be used for bringing the light to a focus on the external system, and the sugar should not be removed from it unless it can be placed in some entirely opaque substance, or in a bottle having the same color as the lens. For this reason water is better, if a person is not going to travel and is willing to take a little more trouble in charging it every few days. To have the advantage of both, two sets of lenses would be necessary. When sugar of milk is charged it would be well not to have the lens full, as an occasional shake will bring the more interior portions outward the better to receive the light, although the light would permeate the whole by turning both sides towards it. I would recommend an amount as large as two or three peas for a dose. I caused a lady who had

been so agitated by a fever that she could not sleep, to sink into a very comfortable slumber by as much of the blue-charged sugar as would lie on the point of my knife, but the sleep became still deeper the next night by doubling the dose. She was delighted with it from the fact that it left no bad influence behind, as opium or chloral had done.

10. The *Blue Chromo-Lens.* After much trouble I have succeeded in getting a very perfect and beautiful blue, or rather what might be called an indigo-blue, very much in resemblance to *ultramarine*, for my lens. Nearly all blue bottles and vials, and most of the blue sheet glass of the day, are colored with cobalt of the mazarine hue, which, as we have seen, transmits a large amount of the hot and exciting rays, quite unfit for the best cooling and soothing purposes. To test blue glass, hold a burning match behind it, or any other artificial light and a strong reddish cast will be perceptible in mazarine panes, or a yellowish cast in some other styles, but the blue lens seems almost absolutely impervious to the red or yellow or other thermal colors, admitting only the blue, indigo-blue, violet and blue green, or the electrical hues. Portions of the lens as seen by sunlight have a violet cast, and I at first feared it might be caused by admitting the red with the blue rays, but on testing it I have not been able to force the least particle of red light through it, and even the violet light of an ordinary lamp is too coarse, or at least too feeble to pass through to much extent. It thus gives great purity of effect which is most desirable in therapeutics. The many cases which I have already enumerated of healing by means of blue light, or by blue and white light, or by objects charged with blue and violet light, show the remarkable value of being able to control this color especially in such cases as the following:—

All nervous and excitable conditions;
Fevers, inflammations and hemorrhages;
All conditions with a surplus of the red element;
Diarrhœa and visceral excitement;
Nausea, pleurisy, palpitation;
Menorrhagia, or excessive menstruation;
Points of acute pain, or too great heat;
Neuralgia, headache, spinal irritation, etc.

In treating the head, especially on the front and upper part,

or the temples, the blue only is a sufficiently soft and soothing color as a general thing, although in the case of some persons who have cold foreheads and dormant conditions from nasal catarrh, the purple or even the yellow may be ventured upon for a short time. In treating the body with the blue, the white light may be allowed to come upon the skin around on the outside of the lens, excepting in the case of erysipelas or extreme irritation of the skin, when blue alone is allowable. In *small pox, scarletina* and other eruptive fevers, it would be desirable to use the yellow-orange lens and a warm sunlight also, at first for a day or two, until the virus is brought outward, if the room is sufficiently warm to prevent catching cold; then the purple may be used for a day or two, and then the blue to cool the fever. The general principles of treatment as explained under the caption of *Chromo-Disc* will apply here. The blue lens must not be deemed weak, because it does not burn like the others. It works with a quiet power. I may not always succeed in getting them made so free from thermal colors as the present stock.

11. The *Yellow-Orange,* or *Amber Colored Lens,* is rather darker than yellow-orange, and while admitting yellow as the leading color, admits also some orange and red and yellow-green, which last, being thermal, works in harmony with the rest. This lens will perhaps be deemed the most valuable of all by a majority of persons, having a vitalizing and warming power, and being especially adapted to such cases as the following:—

All cold, dormant and chronic conditions;
All anæmic or impoverished states of the blood;
All pale, sallow complexions with poor arterial blood;
Constipation of the bowels;
Amenorrhœa, or suppressed menstruation;
Dormant liver, kidneys and lower spine;
All hard, chronic tumors and negative inflammations;
Bronchitis, ulceration of lungs, cold cervix;
Paralysis, chronic rheumatism, chills;
Despondency, stupid brain, dropsy, exhaustion, etc.

The white sunlight may also come in to advantage all around the lens on the person. There are very many cases in which the following condition occurs which may nonplus some persons: The stomach and epigastrium may be hot and irritated, thus calling for the blue principle, while the bowels are constipated,

thus requiring the yellow-orange; what shall be done? The blue lens could be held over the pit of the stomach, and the amber colored one over the bowels simultaneously, or at least during the same sitting; or the yellow charged water may be sipped before each meal in the day-time, and the blue charged water on retiring, to soothe the stomach and bring sleep. This last plan is especially desirable with nervous persons who are costive and wakeful.

12. The *Purple Lens*, which we sometimes have made, is useful—

For animating the venous blood which is purple;
For use over the stomach, spleen, kidneys, etc.;
For animating the blood without being too exciting.

13. The greatest heat will probably be produced by the transparent lens, as the other lenses have been made with too deep a color to transmit all of the rays which they are naturally fitted to receive. While this depth of color makes the lenses somewhat less powerful in concentrating the rays to a focus by refraction, it makes them all the better for charging the water or other substance which may be placed within. They generally prove as powerful as any one will wish to endure, if placed in a hot sun, and brought very near to a focus, especially when window panes do not intervene. The blue lens must be excepted from this remark, as the stock which I have thus far received may be focused upon the hand for many seconds without giving the least perceptible heat, even under the sun's most powerful rays. I have set paper on fire in two seconds with the transparent lens, and this without being able to bring it to a perfect focus. This will show its power as compared with the ordinary small solid lenses, such as will cost from $2 to $4, as they must be brought to several times as fine a point of light and heat before they can ignite paper. Under a moderate sunlight, however, it will not always ignite paper.

14. *Food* or *Drink* can be charged in a few moments by means of the chromo lenses, so as to have it produce different medical effects, according to the color used. I have known a single teaspoonful of yellow charged water to act as a laxative to the bowels, and if a person is constipated he could charge his bread or his beverage through the amber-colored lens for one, two or three minutes, or through the blue lens if the bowels are too free, or when nervousness or sleeplessness occurs.

15. The rock against which some skeptical or rash persons split when dealing with these fine forces, is the desire to have them act with a rude power similar to that of coarse drugs and to have an immediate effect. This will sometimes happen, and the patient occasionally becomes more than satisfied of it, wishing he had taken a little smaller dose of sunlight, but in many cases it works so gently as to be almost imperceptible,—2 hours, 6 hours, 12 hours or 24 hours after it is taken, but its effect is much more lasting than those of ordinary drugs, as it deals more directly with the fine nervous forces. Some are cured of costiveness gradually and effectively by the *yellow water*, and yet cannot tell just when or how it was done. Persons who have an active condition of the bowels, sometimes fail to perceive any effect from the charged water, at least in an ordinary dose, as positive forces seem to be met with positive forces, and one gentleman, after having become cured of habitual constipation and made strong by its means, says it no longer has the same effect upon him. That is all right, for the affinitive conditions which once attracted it are gone and no longer need it.

16. Because the blue light or blue-charged elements tend to soothe and bring sleep, it must not be considered the only thing which can do this. The yellow-charged elements often give a very exuberant feeling, animating the brain, but in many cases they in a short time so animate dormant bowels without causing pain, as to draw the forces from the brain and thus induce sleep.

17. A small assortment of these lenses will constitute a little *drug store in minature*, a veritable *home doctor*, capable of drawing down from the skies those fine celestial medicines which penetrate softly and deeply into the human system, which work radically upon both mind and body, and which must save great suffering and many doctor's bills.*

18. Examples of the great healing power of the different colors of sunlight, or of substances charged by these colors, are given on page 290 onward and page 322 onward, etc.

* The lenses have burnished nickel plated handles which screw on or off at pleasure, and hold a piece of cork air-tight upon a glass screw that projects from the lens itself. The price of each lens, put up in a paper box, carefully wrapped, and supplied with a pamphlet to explain the method of use in different diseases, is $1. A solid lens of the same size would cost $6 to $8. The least outfit should have two

XXXI. The Solarium.

The ancients had small terraces built on the tops of their houses which they called Solaria, and in which they took their sun baths. Something similar but modified to suit modern wants would be admirable. A solarium could be built entirely above the body of a house on the roof, or could be arranged just under the roof in the garret where there is room. The glass in either case should be overhead in order to be exposed to the sun all day, and should run north and south or northeast and southwest, so that when a person lies under it, the head could be to the north or northeast. The glass could be arranged somewhat as in the Chromolume, only having the red-orange longer to cover limbs and feet, or it can be arranged as follows to good advantage, making up the main center of colored glass 15 inches wide, the first color at the north for the head being of cupro-sulphate of ammonia blue glass 12 inches deep, or at least deep blue glass which excludes red and yellow rays, then the mazarine blue 12 more inches, then 4 inches of yellow, then 8 inches of green, then 8 inches of red purple, and then 28 inches of red-orange for legs and feet. For the sake of a fine chemical action, place on each side of the blue panes a strip of red or red-orange glass 2 or 3 inches wide, on each side of the yellow, a strip of violet, on each side of the green, red or dark red, on each side of the red-purple, yellow-green or yellow, and on each side of the red-orange, the blue or indigo-blue (sulphate) glass. Beyond all of this on each side, the clear glass may extend all the way to a

lenses if possible, the amber colored and the blue. A much better outfit would be the amber colored, the blue, and the transparent, which if taken at one time will be put at $2.50, thus saving half a dollar. A still better outfit would be the two colored lenses and three more transparent ones, which latter could have three of the leading solutions made up ready for use at any time, and would be superior to the former where greater heat is desired. The price for these five would be $4. By a very oppressive and entirely unnecessary regulation of the United States Post Office department, no glass of any kind, however free from fluids, or carefully packed in boxes, can be sent by mail, and consequently must be sent by Express or otherwise. When ordered it would be well to send the money in a registered letter, or by a Post Office order, in which last case the Post Master should be requested to make the order payable at station D, New York. By thus paying in advance it saves the expense of the return charges, which would be necessary if sent C. O. D. Lenses having some slight indenture or other flaw, and having a cork instead of a handle, are furnished at 25 cents. Address, or apply to, Babbitt & Co., *Science Hall*, 141 *Eighth St.* (*near Broadway*), *New York.*

width of from 12 inches upward. A lounge can be placed directly under the colored glass lengthwise, or with the foot moved around one side a part of the time, so that much of the body can have the white light as well as the colored light. The children of a household should be sent up into the solarium for a play spell each day, and a plenty of pure air should always be allowed to come in when the weather is not too cold. The power, purity of blood and activity of the skin which children would thus gain, would be quite beyond most people's expectation.

XXXII. The Hygiene of Color in Dress.

1. *White or light colored clothes transmit more light to the body than those of any other color, while black or dark colored clothes absorb the light and degrade it into the coarser principle of ordinary heat.* But the reader may say, Is not an object white from the fact of its reflecting all the colors? How, then, can it transmit them? The white reflects a large amount of all the rays, but all those rays which penetrate the interstices of a white garment sufficiently far, pass on as white ones beyond it from the repulsive nature of all the threads, while a black garment from its great affinitive attraction for all the rays greedily absorbs them and prevents their escape on the other side. A sufficient proof of this is the fact that a black or blue curtain will darken a room far more than a white or buff-colored one. But the dark colored curtain of itself will be warmer than the white one. The experiments of Dr. Franklin, in which he put various colored cloths on the snow, are well known. The darker the color of the cloth, the more deeply did the snow melt beneath it under the solar rays. But this did not signify that the black transmitted the heat most, but absorbed it, and the garment thus warmed melted the snow because of contact with it. If the cloths had been placed some distance above the snow, the light colors, *transmitting* the heat most rapidly, would have melted the snow the most, just as we have seen that yellow and orange and red glass transmit more heat than the blue (XXII.). The rule is that if radiant heat "be entirely transmitted, no elevation of temperature is produced in the body through which it passes," and the very fact that a body grows warm under the heat rays shows that

the rays are not transmitted, but absorbed. For this reason black clothing is much more endurable in winter than in summer, as it absorbs and will not transmit the heat away from the body, being in contact with it, while it also absorbs the sun's rays and converts them more or less into heat. The fact that black is a good radiator of heat does not change the principle, for it radiates toward the body as well as away from it.

2. *As a tonic for the cuticle the full white light is doubtless unsurpassed,* for which reason light-colored clothing has a more animating effect than the dark. A lady physician, who for years superintended the ladies' department of a Turkish Bath establishment, informs me that she can generally tell what ladies have been in the habit of wearing black from the withered appearance of their skin. A certain physiologist has declared that he can cure any person of a cold by causing him to wear white clothing for two days. The skin and its contiguous nerves being thus made active by the light, the lungs, liver and kidneys are far less burdened, and the external system becomes positive and able to resist noxious influences. Of course bathing, friction and pure air greatly add to this power. This animating principle of light comes from the thermal rays, especially the yellow assisted by the red.

3. In a condition of fine health, white *underclothes* next to the skin are doubtless best, as they transmit more or less of all the rays. When a person, however, is very cold, pale and bloodless, red drawers and stockings are admirable, and even red undervests, in case the system is not too excitable. Red stockings are excellent, but if others are worn, red tissue paper can be wrapped around the feet and the stockings pulled over them. I have sometimes intensified the natural vitalizing power of red tissue paper by passing my warm magnetic hand over it several times, after which it has been able to warm the coldest feet, making some so hot in fact that the paper has had to be removed. The same paper charged with white, and especially with red or yellow light, just before putting it on, would warm the feet in a more natural and penetrating way than the coarser heat of hot bottles or flat-irons. For hot pit of the stomach, bowels or spine, blue paper next to the skin and pinned to the underclothes would be admirable, and this could be made still more soothing as a seda-

tive and nervine by charging it with light under blue glass. For an over-heated and excited system, however, blue or lilac undervests of rather thin material are desirable, for although the blue will absorb the heat rays more than yellow or red, yet it reflects the cool electrical principle and has a quieting effect.

XXXIII.—The General Vagueness of Idea Concerning Colors.

1. The darkness which surrounds the subject of light is so great as to be easily *visible* to any thoughtful mind. In fact scientists of high standing, physicians, editors, professors, and men of general erudition in other matters, seem to be in dim eclipse as to the potencies of color and light as well as to their law of action. In this department they see men as trees walking, and one color is about the same as any other, or as all others combined. For these thousands of years has the sun been sending its resplendent power upon the world, and painting its lessons upon all things, and yet men's eyes have not been opened to see them. They stand in the midst of an infinite temple whose pillars and domes link the heavens and earth together, and yet they treat the matter almost as indifferently as they would a dark cavern, and are ready to cast stones at those who, seeing more than themselves, attempt to lead others to witness the same. But as soon as men learn the great fact that the positive side of all force lies in *the fine* rather than *the coarse*, they will gradually cease their cry of "delusion," "fanaticism," etc., and finally be thankful that others have been able to lead them into nature's diviner pathways. Men must first be taken up with the crude and the tangible, and with the more material side of things which is all right, as this must never be ignored, but now, after all these ages of failure in reaching interior principles, it is high time that they should attempt something in advance. I will mention a few examples of popular opinion, admitting also admiringly the great achievements of our scientists in the external phases of this very department of late years.

2. *General Pleasanton*, of Philadelphia, himself not a scientist, but a gentleman of much practical common sense, has laid the world under a debt of gratitude for his very useful experiments with blue and white light, in the development of vegetable, animal

and human life, and for his success in awaking public attention to so important a subject. To be sure this is only one small side of the question, a kind of a one-idea presentation of the subject of light, but I am free to admit that if we were to be limited to one simple combination of colors, it is as good as any other, especially for our nervous and over-active Americans who get thereby the soothing blue, and the diversified power of white light, both of which become chemically intensified by being massed side by side. He has shown by actual experiments, too, how decidedly vegetation can be forwarded in its growth by a small amount of blue, combined with a large amount of sunlight, for which we must thank him. Having helped our common humanity by means of experiments of so much value, we may easily forgive the utterly amorphous arrangement of matter in his book, and the many theories therein advocated which will scarcely stand a crucial test. The danger consists in putting so much stress upon blue as the pivotal color, and leading people to adopt in all cases merely a single combination, which in some conditions of disease must be attended with danger just as in opposite conditions it might be most helpful.

3. *Dr. S. Pancoast,* also of Philadelphia, has gone "one better" than Gen. Pleasanton, inasmuch as he has ascertained that there are two colors which have special potencies. "Red and blue," he says, "are the only absolutely independent colors." In his work just issued, called "Blue and Red Light," he has a chapter of great value in which he gives ten remarkable cures made under his own direction by means of blue and red light, the most of which I have quoted in this chapter. In this color-healing, being a physican, he has shown more discrimination than General Pleasanton, and his results are perhaps more striking. The rest of his work will be considered of but little value by most readers, being founded upon the old Kabbalistic mysteries which, having pursued "for over thirty years," in connection with experiments of his own, have seemingly blinded him to the far grander discoveries of the present. As a specimen of his style, notice the following remarks: "All nature owes its every form and feature of physical life to Light, the mighty unit, not to seven rays. The ancients fully understood this, and they never thought of light as seven rays riding through space on

seven broomsticks, or waving on seven distinct sets of waves; they knew accurately and perfectly all that man can know of the secrets and mysteries of nature—of the essence and nature of light. * * * The ancients knew vastly more of the causal world than all the scientists from Galileo or Newton to the present day have ever learned—incalculably more than the Tyndalls, Schellens, and other wave philosophers will learn for centuries to come, unless they go to these old sages and learn of them" (p. 68). Such infatuation of our author may be accounted for by his having turned square around from the on-marching hosts of the present, and setting his face towards the presumed gods of the past, has marched steadily towards them. Turning briefly to look upon the scientists of to-day, they seem to be far behind himself and the ancients whom he follows, whereas the probable truth is, he and the ancients are far behind them. Too many men are looking worshipfully to the past, and making progress, if at all, backward. The progressive nature of man must, on the average, make the present better than the past, the future better than the present. The ancients had many grand minds in their midst but they lacked instruments, such as telescopes, microscopes, spectroscopes, and a hundred other things which are absolutely necessary to exact knowledge. The printing press alone, to say nothing of the steam engine, the use of gunpowder which is the great peacemaker, the sewing machine and multitudes of other things, would overbalance in importance all of the inventions of the ancient world. But what has this profound wisdom of the past taught our author, as manifested by his writings? One thing which he asserts repeatedly is that *the whole physical universe has light for its source*, it being the universal motor, the one prime source and cause of every motion of the universe," etc. Men are ever prone to ride off on one wheel of the universe and forget all the rest. Thales declared that *water* was the principle of all things, Anaximenes traced all things to *air*, Heraclitus, to *fire*, others to *electricity*, etc. A knowledge of atomic law and chemical action will show that all of these elements and forces are merely sub-agents or wheels in the great machinery of nature, none of which have any creative action. Such reasoning reminds one of a musician who should seize upon a single string of his harp and declare

that all the music is to be found in that, the others being merely inferior members, dependent upon the one. But I have not space here to refer to his many theories, and will simply notice an expression with reference to his favorite two colors :—" Two rays produce the two opposite forces, or principles of light —the red, the positive, polarizing, integrating force or principle ; the blue, the negative, depolarizing, disintegrating force or principle " (p. 267). That the truth is exactly the opposite of what he states here must be quite evident from his own admissions in other places, in which he shows that the red is the heating, and the blue the cooling ray. But as heat is the melting, burning, disintegrating, and depolarizing principle, then must the heat ray, which is red, be the same ; and as cold is the crystallizing, polarizing and organizing principle, so must the cold blue ray have the same effect. The Doctor's medical practice seems to be more correct than his theories, and I would have been thankful for more cases of his color-healing. Before leaving this book I would remark that I know of no ancient who had any but the crudest ideas of color. Aristotle called *yellow, white* and *black* the three primary colors ; Pythagoras had *yellow, red, white* and *black* as the primaries ; Plato supposed that an inward fire in the organ of the eye caused the effect of light, just as Pythagoras recognized a hot vapor emanation as causing the same. Such ideas would not indicate that even these greatest of the ancients " knew accurately and perfectly all that men can know of the secrets and mysteries of nature—of the essence and nature of light." It is folly to let " distance lend enchantment to the view," to such an extent that mankind are to be considered as moving on a *down hill grade ;* for if all the great men belonged to the past, the present must be imbecile in comparison, while the future must sink into idiocy and ruin.

4 The *Scientific American,* a paper with a deserved reputation in the philosophy of mechanics, but evidently quite uninformed with reference to the finer forces, has published a series of articles on the " Blue Glass Deception," as it terms it, which I answered at the time in the *N. Y. Evening Mail.* In these articles that paper presented an array of learned authorities, which, failing to designate the distinctive features of the different colors, and tearing down rather than building up ideas that are well

known and established, their general effect must have been to have deceived the public to a far greater extent than did General Pleasanton, whom they charged with the "Blue Glass Deception." I will quote simply one point as a specimen of its assumptions:—"In some instances where it is desirable to diminish the intensity of light, blue glass may be used; but any mode of shading the light, as by ground glass, thin curtains, would without doubt serve equally as well." In other words, according to this paper, blue has no particular potency, and acts simply as a principle of shadow, thus being a kind of superfluity in nature whose place is better supplied with black. It is high time that the *Scientific American* had learned 1st, that the blue has a great and special chemical power quite different from the solar rays as a whole, and quite different from other simple colors; 2dly, that the blue developes phosphorescence, while shadow will not, the red will not, the yellow will not; 3dly, the blue will develope germination while the yellow and red tend to destroy germination; 4thly, blue light will dash a bottle of hydrochloric acid into atoms, while red, or orange, or yellow light, or shadow will do nothing of the kind; 5thly, blue light will darken the salts of sensitive metals, as in the case of photography, whereas the thermal rays cannot; 6thly, blue is caused by fine vibrations which are cooling in their nature, as shown by the thermometer as well as by sensation, while the red and yellow are caused by coarser vibrations of a warming character. It is sad, then, that the public should be so misled by an influential paper whose words are quoted far and wide and whose authority gives weight to its utterances. The blue also destroys animalcules as will be seen.

5. The *Liberal Club* of New York, which meets at Science Hall, and embraces some gentlemen of fine attainments and real acumen, had a lecture and discussion on the Blue Glass Cure, some time since. The lecturer, though presenting many points of historical interest on the subject, made it his main business to criticize the positions of General Pleasanton. He, like some other members of the Liberal Club, had been misled by the sophistical arguments of the *Scientific American*, and on the whole, although many good things were said, the audience must have left with their ideas more mixed than when they came. The lecturer evidently could not see that one color had any special advantage

over another or over all of the colors combined, as signified in the following language, when speaking of the healing power of light :—"We do not believe that this is increased by any electro-magnetism developed by the interposition of colored glass, for the unmodified sun-light is capable of producing all the beneficial effects which are now erroneously attributed to some added influence of blue glass." This is an assertion unsustained by facts, and contrary to any correct deduction, as according to his own experiments the full white rays of the sun coming through clear glass were far hotter than those which came through blue glass, or through blue and clear glass in equal proportions. Even if we wholly omit the wonderful chemical powers of the blue, is it not plain that its coolness alone would render it more suitable for inflammatory or feverish conditions than the full power of the sun? The remark is often made that "we should use the pure light of the sun as God and nature have given it to us." This is very plausible and very delusive, for, as we have already seen, although the pure white light is best for ordinary use, and especially for well persons, yet in certain conditions of disease the blue is best, in other conditions the yellow, in other conditions still the red or orange. On the same plan we may take water as nature has furnished it, but is it not often best to take hot water, or cold water, or filtered water? It is well to take pure air as nature provides it, but suppose the blood is badly deoxidized and dormant, would it not be useful to take a little oxygen alone at times to bring about harmony, or to have the air changed to greater heat or cold according to conditions? But man is ever modifying nature in his food, sleep, clothing, medicines, and it would be the merest empiricism to attempt to restore the sick by giving vegetables, meat, etc., in their ordinary unchanged condition. So in sunlight, one of the mightiest of all agencies, we shall be empirical if we do not in one case administer the electrical rays, in another the thermal or luminous, in another the concentrated rays, etc., according to conditions. At the same meeting of the Liberal Club, a learned doctor arose and advised the people to "cover the whole windows with blue glass if they chose as a process of shading their rooms, but to avoid the checker-board process advocated by General Pleasanton." Thus the people were counselled to adopt a plan which

would be positively dangerous in many cases, especially if it is to be occupied constantly. Seeing the blind thus ever leading the blind, until people fall into the ditch, and seeing a divine cause thus imperilled, by those who should understand the methods of human upbuilding, is my excuse for dwelling thus long on the subject, and for aiming to establish a definite system of rules founded on Nature, whose paths are ever those of peace and harmony.

A Word to Physicians.

While physicians are doubtless as noble as any class of professional people in the world, and perform many self-sacrificing deeds for the good of the suffering, for some of which they never expect any remuneration, yet like all other people, some of them have their selfish side and their *hard* side. While some grand natures among the medical fraternity are rejoicing in the newly discovered power of light, yet it is very common for practitioners to turn from the matter almost without examination and exclaim "fanaticism," "humbuggery!" Two things lead them to this course, 1st, if the people can thus heal themselves with light it will tend to destroy the physician's practice; and 2dly, it seems impossible that so soft, intangible and noiseless a thing as light can have any special power to heal, and having been educated in the old medical rut, few have the force of character to enable them to get out of it sufficiently to examine an entirely new thing. As to the first point I would say, Fellow Physicians, dare we look into our mirrors and ask the person therein revealed, if he is so base a creature as to let the sick and suffering and discouraged humanity around him moan and die rather than have his income diminished? If so, he is unworthy of the grand title of physician or philanthropist, and the world at large who are quick readers of human motives will gradually dismiss him and press onward to these "waters of life" without his aid. If, however, he can learn to put his whole soul into the upbuilding of his patients with a feeling that he *must* cure them, by whatever agencies of earth or heaven, he will not be allowed to suffer greatly even in his earthly ledger, while his celestial balance account will be triumphantly in his favor. The truth is that the

physician will often be needed for the scientific administering of light, and this though unequaled in some things must also be supplemented by other agencies and by the utmost skill that can be brought into action. Even then he must find himself duly humbled at times by cases which will conquer him. CHROMOPATHY is based on eternal truth, and the sooner any great truth is adopted, the better it is for all concerned. As to the second point, it should be remembered that the mightiest worlds are wafted on the breath of gravitation which is incomparably more intangible and subtile than light, and hence the exquisite and soft character of a force should always be construed in its favor as an element of power instead of weakness. It should be remembered that man occupies the highest scale of refinement in the realms of visible being, consequently the elements which best administer to him must be refined. One great advantage in the finer forces, is that they animate not merely the physical nature, but enkindle the mental and moral faculties into greater activity, whereas grosser elements frequently quicken only the lower animal nature. I appeal, then, to physicians in behalf of humanity, in behalf of their own ultimate success and their own full-orbed development as men of power and skill, and truth, to give loving audience to the great achievements of light and its sublime source in the sky, whose chariot wheel is hinged upon the heavens and must continue to roll on with its almost omnific power, however much puny man shall oppose. Mount the great wheel-work of nature and it will bear you onward triumphantly: oppose it and it will crush you.

XXXIV. SUMMATION OF POINTS IN CHROMO-THERAPEUTICS.

1. *Chromo-Chemistry gives us the basis for the first time of an exact and exquisite Materia Medica.*

2. *Chromopathy deals with more refined and penetrating elements than Allopathy, Hydropathy, or Electropathy.*

3. *The power of Red to stimulate the arterial blood and arouse the system is shown not only in drugs but in cases of healing by red light.*

4. *The red is injurious in over-excited conditions.*

5. *The yellow aided by some orange and red, is the central principle of Nervous Excitement as shown* 1*st, on principles of Chromo-Chemistry;*

2dly, by the potencies of drugs in which the yellow, etc., predominate, and 3dly, by the action of yellow light in disease. Yellow is especially predominant in laxatives and purgatives, and combined with a fair amount of red or orange, forms the leading element in Cerebral Stimulants, Emetics, Diuretics, Diaphoretics, Tonics, Rubefacients, Emmenagogues, etc., the red being especially decided in the latter two.

6. *The yellow is injurious in all over-active, nervous conditions, such as Delirium, Diarrhœa, Sleeplessness, etc., and is the most decided principle in poisons.*

7. *The Violet, Indigo and Blue are Refrigerant, Astringent, Nervine, Soothing, Anti-Inflammatory, etc., the violet being more directly soothing to excited nerves and the blue to excited blood. This is proved not only by principles of Chromo-Chemistry, but by a large number of well known drug potencies in which these colors rule, as well as by these colors in light as attested by the treatment of many diseases.*

8. *Blue and Violet are contra-indicated in dormant, cold conditions, such as paralysis and many chronic diseases.*

9. *Substances charged with the different colors of light possess the same kind of potency as the direct rays themselves, as attested by various cases of disease treated therewith.*

10. *Pure Sunlight is the best for the general use of man and nature, is vitalizing to the general system, especially to the skin, and in warm seasons is particularly stimulating and healing. Tumors, Colds and many other diseases have been cured powerfully by it.*

11. *The Lack of Sunlight induces a long catalogue of diseases, such as scrofula, impoverished blood, consumption, paleness, mental imbecility, etc., etc.*

12. *Strong and hot Sunlight is injurious to hot brains (as in sunstroke), weak and over-sensitive Eyes, etc.*

13. *We have seen that the color potency which each kind of glass transmits is not to be determined entirely by its appearance; thus cobalt (mazarine) blue glass presents a very deep and fine blue with an almost imperceptible amount of red to the eye, aud yet as tested by the prism it admits blue, indigo, violet, green, orange, red and thermel, and is thus imperfect as a glass for the cool principle, while blue glass colored with the cuprosulphate of Ammonia would be far superior. We have seen that although*

the red is the hottest visible color, yet that red glass does not transmit as much heat as the orange or even yellow glass; hence glass must be used according to the power it transmits, and not entirely according to what it appears to the eye.

14. *Blue and violet light are best for inducing sleep in nervous conditions, but narcotics have both thermal and electrical colors which first excite and then depress the system.*

15. *The Chromolume is a beautiful instrument, combining a series of various colored pieces of glass arranged on chemical and physiological laws, and adapted to the various organs of human beings, all of which are covered simultaneously.*

16. *The Chromo-Disc is an instrument which concentrates the rays mainly by reflection, and the Chromo-Lens another instrument which concentrates them by refraction, and both are intended to throw great power on any part of the body which may be the most affected, and thus develop a rapid action.*

17. *The general philosophy of Chromopathy will lead us to apply the electrical rays through blue or indigo glass for all inflammatory, feverish, relaxed, nervous and over-excitable conditions, to apply the red rays through ruby glass, to arouse the arterial blood, the purple rays through purple glass to animate the venous blood and the digestive system, the yellow and orange and red rays through yellow or orange glass to awaken the nervous system and kindle new action in dormant bowels, kidneys, lungs or in cold and paralyzed parts. The cupro-sulphate blue glass already described is the coolest of all; when combined with an equal amount of white light through white or clear glass it is warmer, but less warm than white light alone; the orange, especially the red-orange, is the warmest of all, and when combined with an equal amount of white light the effect is made more cooling. Of course solutions of different colors, or even thin colored drapery can be used in the place of glass. The same general principles as the above, applied differently, should rule in Dress.*

18. *We see, then, that every color has its own peculiar power, different from all the colors as combined in white, or from each of the other colors when taken singly. To say that each or all of the colors have pretty much the same character, and that none of them have any very special potency, as is too generally done, is to assert that the universe has been filled with a*

meaningless array of hues which are quite worthless except as they gratify human fancy.

19. *If these principles of Chromopathy are founded on immutable truth, physicians who oppose them are projecting boomerangs which shall rebound directly into their own faces and into the faces of the suffering community who are confiding their lives into their hands.*

We have thus in light, color and other fine forces, the basis of a nobler philosophy of cure which must rule in the future, from the fact that refined elements alone can be adapted to the higher nature of man, who is himself the most refined portion of the known universe. The coarser elements of his nature can be built up with food or with what may be called *food medicines.*

If drugs are to be taken, only the purer and finer kinds should be administered, and these should be kept in bottles whose color is consistent with the nature of the medicine itself. As this is a department of science in which our druggists and chemists themselves are very deficient, a hint will be in place here. Alkalies, cathartics, emetics, diaphoretics, diuretics, and stimulating substances should be kept in orange or amber colored bottles, while acids, astringents, sedatives, refrigerants and soporific elements should be kept in blue bottles. Even diffused light would have some influence in refining and increasing the properties of the enclosed drugs; but if the full sunlight, or even gaslight, could fall upon them for a time each day, their effect when taken would become more penetrating, refined and enduring.

In the chapter on Chromo Culture of Vegetable Life, it will be shown that the red is most active in developing the reproductive principle in plants. From its power over nervous action, the yellow may be supposed to be most active in animal life, aided also by the red. In proof of this, Dr. Downes and Mr. Blunt, in a paper read before the Royal Society, showed that yellow generates animalcules most rapidly, and red next,—that blue light destroyed animalcules, and even white light would prevent their forming. We know the warm light of summer will generate insect life, while blue light will destroy it, from its axial principle. In yellow fever and other malarial conditions of the system in which animalcules are abundant and produce putridity, blue glass must be invaluable. See next chapter, VIII.

CHAPTER SEVENTH.

CHROMO-CULTURE OF VEGETABLE LIFE.

I. Review of Ground already Covered.

In Chapter Fifth on Chromo-Chemistry, the following departments of this subject, have already been considered :—

1. The law of Chemical Repulsion, by means of which certain color-potencies in the sun-light and atmosphere stimulate the same color in plants (XIX, 1).

2. The brilliancy of plants, and other substances, depends upon the amount of sunlight which they receive (XIX, 12).

3. The germination of Plants is brought about by the electrical colors through chemical affinity (XX, 9).

4. Chlorophyl, the green coloring matter of plants, is formed by chemical affinity (XX, 10).

5. The formation of the bark of trees (XX, 11).

6. The green coloring matter of leaves may be formed under the light of a lamp, but not under a Drummond light (XX, 12).

7. The development of flowers, and the perfecting of their reproductive principle, require both thermal and electrical rays (XX. 13).

8. Why flowers incline to the sun (XX, 14).

9. How the harmonic contrasts of flowers are developed by chemical affinity (XX, 15).

II. Germination.

1. *The Electrical Rays penetrate more deeply into the soil and cause more rapid germination, as well as more rapid sub-soil growth than the thermal rays, or than both thermal and electrical combined as in white light, or than shadow.* The reason of this rapid growth as explained under the law of Chromo repulsion (Chap. Fifth, XIX), is, that the blue principle of light

must stimulate into greater action, the same principle of plants, which is so abundant in their green parts, and it may also awaken their chemical activity, in connection with the soil which abounds in thermal elements. We have already seen that the electrical rays penetrate the soil more deeply than the thermal, because the affinitive thermal elements of the soil draw them on, and probably, too, because they are more fine and penetrating than the others. Robt. Hunt, after trying a great number of experiments with different colors, says:—"In every instance, germination was set up by the agency of the radiations, which had permeated the blue glasses in a less time, and at a greater depth in the soil, than in comparative experiments in which the seed was exposed to the full influence of light, and its associated radiations, as combined in the ordinary solar beam," and declares that "*the germination of seed is more rapid under the influence of the actinic* (*electrical*) *rays, separated from the luminous ones, than it is under the influence of the combined radiations, or in the dark.*" (*Researches on Light, p.* 224.) We have already seen that the thermal rays tend to impede or destroy germination, and most plants cannot germinate at all under the influence of the full white light, for which reason seeds and sprouts must be shut out from the light by being buried in the soil.

2. Mr. Charles Lawson of Edinburgh, wrote a letter to Professor Robert Hunt concerning the germination of seeds, which strikingly illustrates this subject. I quote the following from it:—

"It is our practice to test the germinating powers of all seeds which come into our warehouses before we send them out for sale. Our usual plan formerly was, to sow the seeds to be tested in a hot-bed or frame, and then watch the progress and note the results. It was usually from 8 to 14 days before we were in a condition to decide on the commercial value of the seed under trial. My attention was, however, directed to your excellent work 'On the Physical Phenomena of Nature,' about five years ago, and I resolved to put your theory to a practical test. I accordingly had a case made, the sides of which were formed of glass, colored blue or indigo, which case I attached to a small gas stove for engendering heat; in the case shelves were

fixed in the inside, on which were placed small pots, wherein the seeds to be tested were sown. The results were all that could be looked for: the seeds freely germinated in from 2 to 5 days only, instead of from 8 to 14 days as before. I have made some trials with the yellow ray in preventing the germination of seeds which have been successful; and I have always found the violet ray prejudicial to the growth of the plant after germination."

The last remark should not be construed as meaning that the violet in combination with thermal rays, was prejudicial to the growth of a plant, but rather the violet alone. The violet or blue, may be made a means of intensifying the thermal rays when properly combined with them.

3. "The effect of red or calorific rays," says Prof. Hunt, "is to produce rapid evaporation from the soil, and the surface of the plants; even when this evaporation is met by an increased supply of moisture, germination is much retarded, and the young plant grows slowly, its leaves assuming a brown or red tint, showing that the chlorophyl—the coloring matter of healthy leaves—is prevented from forming" (p. 378). For fuller account of this process of germination, see Chapter Fifth, XX, 9.

III. Healthy Growth above Ground

Requires the thermal as well as the electrical rays, for with the electrical rays alone or in darkness, plants become tender and watery. Woody tissue consists of lignin and other of the harder parts of plants in which carbon, being a very prominent element, the yellow rays are of the first importance, being those which propel the atmospheric carbon into the plant, as was seen in chromo-chemistry, the yellow propelling the yellow. Experiments show that as soon as the first plumules (leaf buds) appear above the soil, it is necessary to have a plenty of luminous and heating as well as electrical rays. Professor Hunt's experiments show that the woody substance was formed most rapidly under a medium in which the yellow (luminous) rays were most abundant, next to which in power came a white medium admitting all the rays in abundance, then a red medium in which the heat rays were most active, and least of all a blue medium with the electrical rays in greatest abundance. "If the young plant," he says,

"continues to grow under the influence of the rays which have permeated the blue, it will for some time grow with great rapidity, producing, however, succulent stalks which soon perish. Even in the earliest stages of growth it will be found that the plants grown in the full sunshine, or under the influence of yellow or red media, representing the luminous and calorific principles, give a larger quantity of woody fibre and less water than those grown under actinic influence." In Prof. Hunt's experiments through the blue medium, many thermal rays were admitted, according to his own estimate, or the plants could not have had the very rapid growth which he speaks of. It is not probable that plants could grow at all under mere thermal or mere electrical rays. Dr. Edward Newberry, of New York, has shown me plants grown under blue glass in which only a comparatively small amount of the thermal rays were admitted, whose growth had been greatly more rapid than those under white light, but their substance was very feeble and imperfect. In his experiments, however, with red-leaved plants, the blue retarded their growth, there evidently being too little of the blue element in them for the blue rays to act upon as a stimulus.

IV. Florescence and the Reproductive Function of Plants.

Require especially the calorific rays on the thermal side of the question, and an abundance of oxygen on the electrical. "I have rarely succeeded," says Prof. Hunt, "in getting plants to flower under the influence of any of the media which cut off those rays usually termed the calorific rays. For instance, under intense yellow, deep blue, or very dark green glasses, however carefully the plants may have been attended to, there was seldom any evidence of the exertion of their reproductive functions. * * By removing plants when in a healthy condition from the influence of isolated light or actinism, to a situation where they may be exposed to the effects of those heat radiations which are of the least refrangible class, flowers and seed are rapidly produced." (p. 237.)

We have already seen in Chapter Fifth, XX. 13, from the experiments and opinions of Priestly, Scheele, Ingenhousz, and Saus-

sure, that *flowers require more oxygen than any other portion of the plant, and will not be developed without it.* For this reason they should not be shut up too much in close air, and must also have heat and moisture for their finest unfoldment. But mere heat in its coarser forms will not answer, the grade of heat which is manifested in the red color being necessary, as has been shown by experiment. "*If the red rays are obstructed, flowers will not form.*" The thermel also combines with the red in the process of florescence.

V. Blue and Transparent Glass for Hot Houses, etc.

1. While blue glass by the side of an equal quantity of clear glass does not increase the heat within an enclosure, a large proportion of clear glass, with a small proportion of blue combined, must add considerably to the heat, according to the experiments of General Pleasanton of Philadelphia, and according to a principle which we have seen to be true, namely, that the greatest possible heat is developed by combining a certain amount of electricity with thermism. General Pleasanton conveys the impression, however, that an equal amount of blue and clear glass causes a greater heat than clear glass alone, but this is disproved by all experiments that I have ever known on the subject. We have seen that orange colored glass transmits a greater heat than red glass itself, or even than transparent glass. Why is its heat greater than that of the red glass as long as the latter transmits red and thermel, the very hottest of all the rays? Evidently because the orange glass transmits not only these hot rays but a small portion of blue and green as an intensifying principle. In the same way when General Pleasanton arranges his Grapery with only one-eighth of his lines of glass blue, and the rest transparent, the electrical rays transmitted by the blue, seizing the contiguous and affinitive portion of the white rays, create such a chemical activity as to increase not only the heat, but the potency of all the rays, as both theory and practice show. It occurs to me that if a strip of red glass three or more inches wide on one side of the blue, and of orange on the other side, and then a half a dozen lines of clear glass would create a still greater chemical power as there would then be masses of af-

finitive rays thrown side by side. If the red should be considered rather exciting, a yellow glass would perhaps be almost, if not quite equally good, especially to place on one side of mazarine blue glass, while the orange or red-orange is on the other side. Such an arrangement would seem especially desirable for conservatories in which the leading object is to develop flowers, as we have seen that the red principle which passes freely through both orange and yellow glass, is a necessity in floriculture. Where flowers are the leading object, another combination would probably be still better, namely, a half a dozen lines of clear glass, and then a line of red or red-orange glass, with a strip of blue on each side.

2. The *Heat* caused by having every eighth row of glass of mazarine blue, and then seven rows of ordinary transparent glass in the grapery of General Pleasanton, is described as follows in "Blue and Sun-Lights":—"On the 31st day of March, 1872, I visited my farm to give directions to apply heat to start the growth of the vines in my grapery at the commencement of the season. The weather was very cold, patches of ice and snow lay in places on the fields, which the sun shining with great brilliancy was unable to soften or melt. In the open air, protected from sunlight, the thermometer (F) marked 34°, 2° above the freezing point of water. On entering the grapery in which there had been no artificial heat from fuel of any kind for the space of nearly a year, my son and myself were astonished at the great heat that there was within it. On examining the thermometer which hung on one of the middle posts of the grapery, completely sheltered from the sunlight, about 4 feet from the floor, we were amazed to find that it marked 110° F. Here was an increase of 76° of temperature over that of the outside air, and produced by a film of glass not exceeding one sixteenth of an inch in thickness, but associated as blue and plain glass. * * I have had occasion to observe since that date, that during the passage of strong sunlight through the blue and plain glass of the grapery, the temperature through the day within the grapery varied from 106° to 115° (F.), while that without, at the same times of the day would range from 32° upward to 60° or 65°" (p. 46).

VI. The Marvelous Vegetable Growth

1. Caused by this arrangement of blue and clear glass is thus detailed by General Pleasanton, the account of which has already attracted attention on both sides of the ocean:—"On a venture I adopted (caused) every eighth row of glass on the roof to be violet colored,* alternating the rows on opposite sides of the roof so that the sun in its daily course should cast a beam of violet light on every leaf in the grapery. Cuttings of vines of some twenty varieties of grapes, each one year old, of the thickness of a pipe-stem, and cut close to the pots containing them, were planted in the borders inside and outside of the grapery, in the early part of April, 1861. Soon after being planted the growth of the vines began. Those on the outside were trained through earthen pipes in the walls to the inside, and as they grew they were tied up to the wires like those which had been planted within. Very soon the vines began to attract great notice of all who saw them from the rapid growth they were making. Every day disclosed some new extension and the gardener was kept busy in tying up the new wood which the day before he had not observed. In a few weeks after the vines had been planted, the walls and inside of the roof were closely covered with the most luxuriant and healthy development of foliage and wood."

"In the early part of September, 1861, Mr. Robt. Buist, Sr., a noted seedsman and distinguished horticulturist, from whom I had procured the vines, having heard of their wonderful growth, visited the grapery. On entering it he seemed to be lost in amazement at what he saw; after examining it very carefully, turning to me, he said, 'General! I have been cultivating plants and vines of various kinds for the last 40 years; I have seen some of the best vineries and conservatories in England and

* To call Mazarine blue glass "violet colored," is a misnomer, and an error which is quite too commonly adopted by the public in general. The use of this word was corrected by the General in another place. I once inquired of a dealer in New York if he kept violet colored glass. He said he did and forthwith showed me some mazarine blue glass. I informed him that it was not violet. "It isn't, hey?" said he triumphantly, and forthwith lighted a match and held it behind it, as dealers are apt to do, thus giving it a reddish appearance near the light. I informed him that the redness came from the red light of the match, and that sunlight was the true test of color, holding it up to which only the sharpest perception could see any red at all. It is really nearer an indigo than a violet.

Scotland, but I have never seen anything like this growth.' He then measured some of the vines and found them 45 feet in length and an inch in diameter at the distance of one foot above the ground; and these dimensions were the growth of only five months! He then remarked. 'I visited last week a new grapery near Darby, the vines in which I furnished at the same time I did yours; they were of the same varieties, of like age and size when they were planted as yours; they were planted at the same time with yours. When I saw them last week they were puny, spindling plants not more than five feet long, and scarcely increased in diameter since they were planted—and yet they have had the best possible care and attendance!' The vines continued healthy and to grow, making an abundance of young wood during the remainder of the season of 1861."

2. "In March, 1862, they were started to grow, having been pruned and cleaned in January of that year. The growth in this second season, was, if anything, more remarkable than it had been in the previous year. Besides the formation of new wood and the display of the most luxuriant foliage, there was a wonderful number of bunches of grapes, which soon assumed the most remarkable proportions—the bunches being of extraordinary magnitude and the grapes of unusual size and development."

3. "In September, of 1862, the same gentleman, Mr. Robert Buist, Sr., who had visited the grapery the year before, came again—this time accompanied by his foreman. The grapes were then beginning to color and to ripen rapidly. On entering the grapery, astonished at the wonderful display of foliage and fruit which it presented, he stood for awhile in silent amazement; he then slowly walked around the grapery several times, critically examining its wonders; when taking from his pocket paper and pencil, he noted on the paper each bunch of grapes, and estimated its weight, after which, aggregating the whole, he came to me and said, 'General! do you know that you have 1200 pounds of grapes in this grapery?' On my saying that I had no idea of the quantity it contained, he continued, 'you have indeed that weight of fruit, but I would not dare to publish it for no one would believe me.' We may well conceive of his astonishment at this product when we are reminded that in grape growing

countries, where grapes have been grown for centuries, a period of time of from five to six years will elapse before a single bunch of grapes can be produced from a young vine, while before him in the second year of the growth of vines which he himself had furnished only 17 months before, he saw this remarkable yield of the finest and choicest varieties of grapes."

4. "During the next season (1863) the vines again fruited and matured a crop of grapes estimated by comparison with the yield of the previous year to weigh about two tons (4000 pounds !) ; the vines were perfectly healthy and free from the usual maladies which affect the grape. By this time the grapery and its products had become partially known among cultivators, who said that such excessive crops would exhaust the vines, and that the following year there would be no fruit, as it was well known that all plants required rest after yielding large crops ; notwithstanding new wood was formed this year for the next year's growth, which turned out to be quite as large as it had been in the season of 1863, and so on year by year the vines have continued to bear large crops of fine fruit without intermission for the last nine years. They are now healthy and strong, and as yet show no signs of decrepitude or exhaustion."

5. The following is quoted from a letter of Commodore Goldsborough of the U. S. Navy, to Gen. A. J. Pleasanton, with reference to plants grown under alternate blue and clear glass : "In a very short time the plants began to manifest the effects of the remarkable influences to which they had been subjected. Their growth was rapid and extraordinary, indicating unusual vigor, and increasing in the length of their branches from an inch and a half to three inches, according to their species, every 24 hours, as by measurement."

In the above experiment there was evidently too much blue to develope hard and healthy conditions of the plants.

VII. Plants which become withered and Parched

By too much of the thermal rays, are properly revivified by the affinitive blue and violet rays.

1. Gen. Pleasanton gives an account of an experiment which Mr. Buist made with a number of geraniums, many of which

became sickly, some died, some lost their leaves, and others the brilliancy of their colors. "It occurred to Mr. Buist that if he should paint with a light blue color the inner surface of each pane of glass in one of his houses, having a margin of an inch and a quarter in width of the glass in its uncolored condition all around the painted surface on each of the panes of glass, and then place his sickly geranium plants in the house under this glass so painted, the vigor of his plants might be restored. The experiment was made and was successful. The plants began to revive soon after they had been placed in this house. In two days thereafter, they began to put forth new leaves, and at the end of ten days their vigor was not merely restored, but were more healthy and vigorous than he had ever seen similar plants of the same varieties to have been. Their colors were not only restored, but their tints were intensified."

2. "A lady of my acquaintance," says Gen. Pleasanton, "residing in this city, informed me that having some very choice and rare flowering plants in pots in her sitting room, which were drooping and manifesting signs of disease, she threw over them a blue gauze veil, such as ladies wear, and exposed them to the sun-light, when she was highly gratified to discover that in a very short time they were fully restored to health and vigor."

VIII. Insect Life as Influenced by Colors.

1. As the thermal light is a principle of reproduction in vegetable life (See IV.), it is doubtless the same in animal life, especially as it is well known that an increase of heat up to a certain point developes countless animalcules throughout the air and water, as well as in animal and vegetable life. This being the case, the contrasting *principle of blue must have the opposite effect and tend to destroy all insects which are the result of heat.**

2. This, and the following paragraph, I extract from General Pleasanton's work:—"A professional gardener in Massachusetts, near Boston, had been trying for several years to protect his young plants, as they were germinating, from various minute insects which fed upon them sometimes as soon as they were formed. For this purpose he adopted nearly every expedient of which he had any knowledge, and even used the primary rays of

* Since writing the above, Dr. Downes and Mr. Burns have confirmed it by showing that the yellow then the red develop animalcules most rapidly.

sunlight separately. Nothing succeeded, however, in these experiments but the blue ray, which proved itself to be a perfect protection against the attacks of these insects. He made a small triangular frame, similar in form to a soldier's tent, covered it with blue gauze, such as ladies use for their veils. Having prepared a piece of ground, he sowed his seed in it, and covering a portion of the ground thus prepared with his little blue frame and gauze, he left the other parts exposed to the attacks of the insects. His plants outside of this frame were all eaten by insects as soon as they germinated, while those under it escaped entirely from their depredations. This experiment was tried many times and always with similar results."

3. "Having introduced blue glass into the windows of the sleeping apartments of my servants in one of my country houses, it was observed that large numbers of flies that had previously infested them, were dead soon after its introduction, on the inside sills of the windows" (p. 3).

4. In the foregoing cases the "primary rays of the sunlight" had no power to destroy the insect life, but the blue did have the power. This is still another fact which overthrows the assertion of those uninformed people who declare that neither blue nor any other color has any power which is not possessed by ordinary white light. In fact the ordinary white light of summer greatly increases the amount of insect life.

IX. Effects of Light and Shadow on Plants.

1. Many sensitive flowers and plants close up at the approach of darkness as if in sleep, and are awakened in the morning by the stimulating power of light. DeCandolle showed that artificial light will awaken them. Constant shadow would soon destroy the life of plants entirely.

2. Although color is much more negative at night than in the day-time, other laws of force reign in full power during the darkness. "When obscurity overspreads the earth," says Pouchet, "all at once, every flower of the *cactus* displays its innumerable long yellow and white petals, and its corona of 500 stamens waves and trembles around the pistil, then its vast calix exhales the odor of vanilla which perfumes the whole green house."

The *cacalia ficoides*, cited by Liebig, assimilates oxygen during the night, and by morning becomes as acid to the taste as sorrel. By the influence of the sun's thermal rays it loses this taste by noon, and becomes bitter by evening. Prof. Robt. Hunt and others have shown that even in the night plants do not wholly cease to emit oxygen. The upward radiations of the earth may assist in this.

X. Light of Plants.

Mademoiselle Linnæus first discovered that the flowers of the monkshood sent out passing gleams of light, which were generally attributed to electricity. This seems to be a kind of phosphoresence developed in connection with the vital electricity of the plant.

XI. Affinities and Repulsions of Plants.

Mathiolus spoke of the "friendship of plants." "Indeed," an old botanist says, "that there is so much affection between the reed and the asparagus, that if we plant them together both will prosper marvelously." "A kind of sympathy between certain plants has long been observed to exist, as if one loved to be under the shade of the other. Thus on the banks of our rivulets the amaranth colored flowers (inclining to violet) of the purple *loosestrife* (Lythrum salicaria), constantly adorn the vicinity of the willow. Other plants, on the contrary, seem to experience an aversion, one for the other, and if man inconsiderately compels them to approach each other, they languish, or die. The *flax* plant, for instance, seems to have an antipathy for the *scabiosa arvensis*" (*Pouchet's Universe, p.* 462). This seeming friendship among plants is doubtless owing to their chemical affinity, and their repulsions, to there being too much sameness of elements. Thus the loosestrife, spoken of above, in which violet is a strong principle, harmonizes with the willow in which yellow is a strong principle, just as we have seen that yellow and violet always form a chemical attraction for each other.

XII. Color as Related to Fragrance.

Alfred Russel Wallace of England has shown in Macmillan's

Magazine, that the flowers having the most showy colors are less fragrant than those which are white or pale or possessed of modest colors. This seems to have a kind of a parallelism to the fact that most birds having a gorgeous plumage are poor singers. "The sweet odors of flowers, like their colors," says Wallace, "seem often to have been developed as an attraction or guide to insect fertilizers, and the two phenomena are often complementary to each other. Thus many inconspicuous flowers—like the mignonette and the sweet violet—can be distinguished by their odors before they attract the eye, and this may often prevent their being passed unnoticed; while very showy flowers, and especially those with variegated or spotted petals, are seldom sweet. White or very pale flowers, on the other hand, are often excessively sweet, as exemplified by the jasmine and clematis; and many of these are only scented at night, as is strikingly the case with the night smelling stock, our butterly orchis, the greenish yellow *Daphne pontica* and many others." He then refers to Mongredien's work which gives a list of sixty species of fragrant flowers of which more than forty are white and a number of others have greenish, yellowish or dusky inconspicuous flowers.

XIII. Adaptation of the Seasons to Vegetable Growth.

Prof. Pynchon in his "Chemical Forces," thus sums up what scientists have discovered with reference to the influence of the seasons on plants:—"There seems to be a nice adaptation of sunlight to the varying condition of vegetation, at the different seasons. In the spring, when the process of germination is going on, there is a large excess of chemical (electrical) rays, which, as we have seen, tend powerfully to hasten the process. The excess of the chemical rays at this season of the year, is proved by the greater facility with which photographic operations may be carried on. As summer advances, and the influence of the illuminating rays is required to promote the decomposition of carbonic acid by the leaves, and the consequent growth of vegetation, the quantity of the illuminating and heating rays both increase in a very great degree relatively to the chemical

rays. In the autumn as plants approach maturity, and as seeds are to be formed and fruit ripened, the illuminating and chemical rays both diminish, and the heating rays are increased. This furnishes a very extraordinary and curious instance of design in nature. Advantage is often taken of these principles by the horticulturist in the cultivation of plants. When the seeds are to be forced, they are covered with dark blue glass, because this absorbs all the illuminating and calorific rays, and allows only the chemical rays to reach the plant. As the plant advances toward maturity, light is needed, and yellow glass is substituted in place of blue. When the period of maturity arrives, heat has become more essential, and red glass is employed in place of the yellow. In this manner the gardener closely imitates the changes in the composition of sunlight which are made in nature" (p. 264).

XIV. Summation of Points concerning Vegetable Life.

1. *For many things concerning the germination, growth, and chemical principles concerned in the development of plants and flowers, see Chapter Fifth.*

2. *The electrical rays penetrate the soil and cause germination; the thermal rays, or the solar rays as a whole, in most cases prevent or destroy germination.*

3. *The healthy growth of plants above ground require both the thermal and electrical rays, the solid and woody fibre being unable to form without the luminous rays, especially the yellow, to deposit carbon from the atmosphere.*

4. *The flowering, seeding and fruitage of plants are accomplished more by the red and thermel than by the other rays.*

5. *The heat of hot houses and the progress of healthy vegetable growth, is increased to a remarkable degree by a small amount of blue combined with a larger amount of clear glass.*

6. *Withered plants are often revived by blue rays.*

7. *The electrical colors which are transmitted by blue glass often destroy the insects which feed upon plants.*

8. *Light animates and quickens the action of most plants: shadow renders them more negative and is favorable to oxydation.*

9. *Plants are affected by the chemical affinities and repulsions of other plants near them.*

10. *Brilliantly colored flowers are less apt to be fragrant than those which are white or inconspicuous.*

11. *The spring time of the year is cooler, and consequently more electrical and better adapted to germination than the summer, while the summer and early autumn are better adapted to fruit and seed than the spring, from the force of the thermal rays.*

CHAPTER EIGHTH.

CHROMO-PHILOSOPHY.

1. The Plan of this Chapter

Will be to present a few leading ideas concerning Refraction, Reflection, Absorption, Transparency, Polarization and some other points which, under the ordinary theories, are but dimly apprehended, while the general points of optical mathematics will be almost wholly omitted. These are already ably presented in various works, and it is important that I dwell somewhat upon points which should be cleared if possible of their confusion. The ordinary dynamic theory of force being only one side of truth, renders it about as difficult to get a clear perception of optical and many other facts, as it is to drive a carriage with one wheel, whereas a mere child can comprehend the leading ideas of the subject if presented in harmony with nature. Suppose we try to make a child understand the *reflection of light* by telling him that light consists of waves of some fixed ether which sometimes sweep obliquely against an object and then roll off just as obliquely away from it. He naturally thinks of waves of water, which will often roll up against an object and then break into all kinds of confused shapes, and of course scarcely gets the least correct idea of the movement of light. Tell him, however, that light consists of ether made up of countless little fire-balls which strike against an object, and bound off just as any other wonderfully elastic balls will do, and he has some conception of the matter immediately. Seeing a red object he asks what makes it look so red? The answer will be, because it reflects red waves of light and absorbs all the rest. But why does it reflect the red waves, and why absorb the others? The teacher now is nonplussed, for being unable to understand the matter for himself, much less can he explain it to another. The child, however, can

get some idea of the matter when he is told that all red bodies have a little spring-work in each of its atoms which vibrates with lightning speed and is of just the right size and style to dash the fire balls of the red light in all directions, some of which coming to the eye give the effect of red, while the other parts of the atoms act as little suction springs to draw in the other colors and hide them. The explanation of refraction, transparency, absorption, etc., becomes very simple when explained on this more natural plan which is in harmony with all things around us.

II. Refraction.

1. The learned Dr. Eugene Lommel, Professor of Physics in the University of Erlangen, presumes to put a final extinguisher upon the theory which considers light as a material or fluidic element, as follows :—"On this (material) view, refraction is explained by supposing that the particles of a refracting medium exert an attraction or influence upon the supposed luminous substance, and the conclusion is arrived at that light propagates itself more rapidly in the strongly refracting medium than in the feebler one. The direct contradiction which is presented by these opposite conclusions affords an opportunity of finally settling the long contest between the material and undulatory theories of light. Foucault has shown by means of very ingenious experiments that light does travel more slowly in water than in air. If, therefore, the reasons formerly adduced should still be considered to leave any doubt in regard to the nature of light, there can now be no question that the undulatory theory must be regarded as the only true theory of light." (*Light and Color*, p. 237.)

2. The above man of straw, which the Professor has been demolishing, has no real bearing upon the case, as refraction has nothing to do with the slowness or swiftness of the propagation of light either in or out of the refracting medium. It seems to me that the mists which have so long surrounded this subject may be cleared away by the following explanation which would appear to be a triumphant proof of the correctness of the etherio-atomic law. A few words with reference to the nature of re-

fraction will be appropriate. In fig. 172, *si* represents a ray of light passing through a line of polarized atmospheric atoms to a piece of glass. At *i* the atmospheric atoms do not, of course, enter the glass, but their spirals striking it obliquely, find a harder and more resisting medium which gives a jolt to the ethers that flow through them, *bending* or *refracting* them farther towards a perpendicular line in the direction *ir*. Having reached *r*, the atoms of glass pass the luminous ethers on into the less resisting medium of the air again, whose lines of atoms being more yielding than those of the glass are swung around a little at *r*, so that the pathway of the light is afterward exactly parallel to the general direction which it pursued from *s* to *i*, in case the outlines of the refracting medium are parallel.

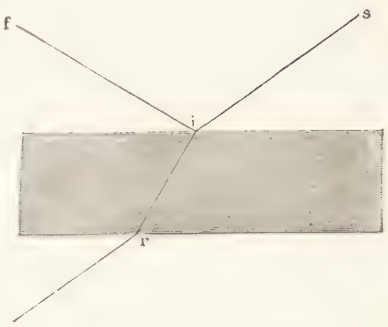


Fig. 172. Refraction and Reflection.

3. But the refraction of the individual colors is seen in fig. 173, in which 1 is an aperture to let in a solar beam, 2 is the prism by which it is refracted, while the separated colors from the visible solar spectrum from red to violet, above and below, which

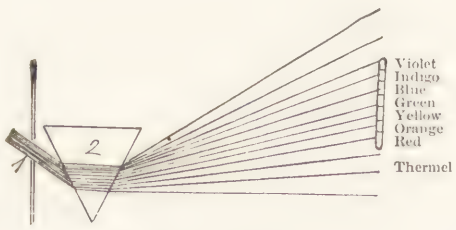


Fig. 173. The Spectrum.

} TRANS-VIOLET RAYS. Professor Stokes has traced these to a distance ten times as great as the length of the visible Spectrum.

} THE SOLAR SPECTRUM, or range of the visible rays.

} TRANS-RED RAYS. These have been traced more than twice the length of the visible Spectrum by Müller.

are the invisible trans-violet and trans-red rays that are many times more than the visible. How is it that all the colors are thus shaken apart, the red being refracted the least, and the violet the most of the visible rays? This is very easily understood if we remember that the color spirals of the atmospheric atoms

through which the rays of light pass, become more and more fine and consequently elastic as they go from the red up to the violet, thus :

The extreme	red	vibrates	458,000,000,000,000	times	per second.
„	Red	„	471,000,000,000,000	„	„ „
„	Orange	„	506,000,000,000,000	„	„ „
„	Yellow	„	535,000,000,000,000	„	„ „
„	Green	„	577,000,000,000,000	„	„ „
„	Blue	„	622,000,000,000,000	„	„ „
„	Indigo	„	658,000,000,000,000	„	„ „
„	Violet	„	699,000,000,000,000	„	„ „
„	H. grade of Violet		727,000,000,000,000	„	„ „
„	Extreme Violet		789,000,000,000,000	„	„ „

4. If the number of vibrations to produce an average thermel should be put at 425,000,000,000,000, then the upper thermel must have twice as many, or 850 trillions, as each octave of colors, like the octaves in music, must be made with double the number of vibrations of the one below it. This is in accordance with the supreme system and harmony which reigns everywhere in nature.

5. The waves of the solar ethers caused by these vibrations are so small that, in the case of the red, it would require about 39,000 of them to extend one inch, while the violet gives about 60,000 waves to the inch. Now suppose a fasciculus, or beam of light, to strike a glass prism diagonally, the orange spiral of the atmospheric atoms through which it comes, being finer than the red spiral, must jolt its luminous contents further one side than the red can do, while for the same reason the yellow spiral must jolt or refract its contents farther than the orange, the violet farther than the yellow, and the trans-violet still farther. Is not the separation and refraction of all the rays then beautifully accounted for in this way? And is not the whole process an almost irresistible argument, to show that the luminous ethers must come through elastic atomic channels in harmony with the foregoing atomic law?

6. Fig. 174 shows how the different rays of light are drawn to a focus, or rather to different foci by this same power of refraction. 1, 2, 3, 4, 5, are different rays of light falling upon a double convex lens; 3 is not refracted as it strikes the glass

perpendicularly; the electrical rays which are the most refrangible come to a focus sooner than the others at or near the point E; the luminous rays near L, and the heat rays near H. If, therefore, in using a lens, the greatest heat be required, we must not expect it exactly where the light comes to the most intense and dazzling point, but a little beyond; if we wish the largest quantity of the yellow principle without the electrical rays we must bring the rays to a luminous point on the object; if we wish the electrical rays also, we must bring the lens a little nearer to the object, while for the trans-violet rays it must be still nearer. The more convex the surfaces of the lens are, the shorter will be the foci. Objects seen through a convex lens are magnified; those seen through a concave lens are diminished, exactly contrary to what is the case with objects seen in convex and concave mirrors.

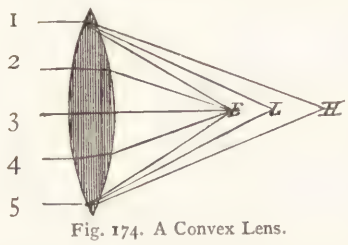


Fig. 174. A Convex Lens.

III. The Reflection of Light.

1. This will be treated of here in only its salient points, and with a desire to correct some misconceptions that scientists have fallen into on the subject. *All reflection of light is caused by chemical repulsion.* But here the critic may meet me with such words as these:—"Have you not said that the reflection of light is simply the rebound of incandescent particles of matter, in other words, of immensely elastic and minute fireballs? Would you assert that the bounding of a ball is an act of chemical repulsion?" The bounding of a mass of matter called an India rubber ball would not be chemical repulsion, in its ordinary sense, because chemical forces deal with atoms and molecules, not with masses as such. In these phenomena of light we deal with atoms and consequently with chemical laws. But we may take a reddish metal like copper, and when it becomes oxydized its surface is dim because its atoms are but feebly active so that its forces are influx and absorptive rather than repellant. Let its surface be burnished, however, and all its external atoms will be

thrown into the greatest activity, its animated spirillæ repelling the rays of light, especially those which are red-orange, into our eyes, and thus giving a flashing appearance. Again submit the same metal to a red, and especially a white heat, and the repulsion is much greater still, dashing the rays back into the eyes until they become almost dazzled. Exactly the same principle of repulsion or reflection of light exists when the copper is made to burn with a flame, for then not only the incandescent metal repels the light, but the incandescent contiguous gas which constitutes flame also. If we ignite strontium its flame repels red light, while ignited sodium repels a yellow-orange, ignited mercury a pale blue, ignited arsenic a beautiful lilac, and so on with all other substances which, when excited, repel certain colors in all directions according to which of the color spirals may have the most repellant activity.

2. The mistake of the scientists of the day seems to be that of supposing all self-luminous bodies to have the power of absorbing the very same colors which they emit, not realizing that a yellow flame is repulsive of the yellow principle just as much as is a yellow object which is cold, and even much more intensely so, while the same is equally true of all other colors. They admit the principle that *similars repel*, but here all at once they make similars attract and absorb each other quite contrary to all principles of chemical affinity. In making these remarks I am not denying that a certain fine element of each color may be, and probably is, received into the spirillæ of each atom similar to the coarser element that is reflected from these same spirillæ, but whenever a flame looks red it must be because the red spirillæ of ignited gaseous atoms repel the red ethers to our eyes, rather than transmit them through their interior channels, heat being especially repulsive. A knowledge of atomic action makes this subject doubly clear. That which has led to this error seemingly is the effort to account for the dark Fraunhofer lines in the solar spectrum. The luminous vapor or flames of different substances gives bright lines in the spectrum. Why, then, does the sun give a spectrum with dark lines perhaps in the very same places? They account for this by asserting that the luminous atmosphere of the sun *absorbs* the similar elements that are thrown out from the intensely incandescent surface of the

sun, the luminous sodium of the photosphere, for instance, absorbing the rays that are sent out by the still brighter luminous sodium of the sun's body, and so with iron, magnesium and other substances. To prove this they throw a sodium flame into the spectroscope, and it casts the double bright band of yellow-orange at D, but when they place a much brighter light beyond that so that the sodium flame comes between the bright light and the spectroscope, a comparatively dark line appears in the very same place, thus showing, as they say, that the sodium light has *absorbed* the sodium rays from the brighter light, and left a dark line where before was a brighter one. Had they but put the word *reflected* or *repelled* in the place of *absorbed*, how completely it would have harmonized with the principles of all known science, besides explaining the phenomenon in question on the most simple plan. Notice a little more minutely how this principle must act in the propulsion of solar light earthward. The sodium of the sun's surface, wrought up to an intense brightness by the immense heat and chemical action, propels in all directions with tremendous force the sodium ethers which are of the right grade of fineness to constitute the D grade of color in the spectrum. Sodium must repel or reflect sodium, iron must repel iron, etc. Nothing else in the known universe can systematically do this, otherwise the spectroscope cannot be trusted. As the fiery emanations of the sodium move outward from the sun's surface they encounter the luminous sodium of the photosphere, which at once repels at least its coarser particles towards the sun, being deprived of which the sodium line in the spectrum is shorn of its brightness sufficiently to be called dark. That grade of ether, however, which is fine enough to enter the sodium spirillæ must pass on to the earth and be represented among the luminous portions of the Solar Spectrum.

3. To show how eminent men are settling down upon this great error as an established fact just as they are becoming more and more persuaded that a mere dynamic theory of force is a scientific truth, I will quote the following from Schellen's excellent work on Spectrum Analysis:—"Ångström gave expression as early as 1853 to the general law that the rays which a substance absorbs, are precisely those which it emits when it becomes self-luminous. In the year 1860, Kirchhoff published his

memoir on the relation between the emissive and absorptive powers of bodies for heat as well as for light, in which occurs the celebrated sentence: 'The relation between the power of emission and the power of absorption of one and the same class of rays, is the same for all bodies at the same temperature,' which will ever be distinguished as announcing one of the most important laws of nature, and which on account of its extensive influence and universal application will render immortal the name of its illustrious discoverer." Tyndall also states that "a body absorbs with especial energy the rays which it can itself emit" (*Notes on* Light and Electricity), and scientists generally have adopted this form of expression, the tendency of which is constantly to mislead the mind with regard to the philosophy of luminous action. How important it is that our scientific men, to whom the intelligent world looks for guidance, should build upon correct basic principles.

4. All tangible substances reflect more or less of the rays of light; thus, mercury reflects two-thirds of all the rays which strike it perpendicularly, while even water reflects 18, and glass 25, out of every 1000 under the same circumstances. This shows that even the so-called transparent substances do not transmit all of the rays. When the light strikes obliquely on a substance, the reflection is far greater. Thus, at an incidence of 40° from the zenith water reflects slightly more than a fiftieth of all its rays; at an angle of 60°, one fifteenth; at an angle of 80°, one-third; and at an angle of 89½°, which is nearly in a horizontal direction, nearly three-fourths. In fig. 172, most of the rays are received and refracted in the direction of *ir;* but a few will always be *reflected* in the direction of *if*, which forms the same angle with the glass as does the incident ray *si*.

IV. Absorption.

1. The absorption of light or color takes place in all substances which have a special *chemical affinity* for this light or color. This affinity attracts the rays into the substance itself so as to hide their color and yet not so strongly as to send them entirely through and beyond it as in transparent substances. One cause which prevents the rays from being transmitted entirely through a substance, is doubtless, in many cases, the presence of

transverse polarizations of the atoms, which establish counter and impeding currents, just as transverse and amorphous conditions in electricity prevent good conduction. Some examples will illustrate this point: thus a substance like soot has an affinity for all colors sufficient to draw them within the surface and present a black appearance; snow has a repulsion for all of the colors and reflecting them all into our eyes gives the effect of white; blood has a repulsion for red, an especial affinity for blue, and a sufficient attraction for the other colors to draw them in out of sight, thus leaving only the red visible; an orange repels the orange color and attracts all the rest, especially the indigo; gold repels the yellow and attracts all the other colors, especially the violet, and all opaque substances attract and absorb all the colors excepting that which appears or is reflected to the eye, having necessarily the greatest attraction for the color which forms the chemical affinity of the one which is visible. In substances like colored glass it is the transmitted colors which are visible, while the rest are either absorbed or reflected; thus in red glass the red color is much of it transmitted, while the other colors are either absorbed or reflected.

2. In substances which are gray, like the ordinary granite, a part of all the rays are absorbed and a part of all reflected, thus forming a compromise between white and black; in *red-gray*, a part of all the colors are absorbed, and a part of all, especially the red, are reflected, the red being in predominance. This is less properly called *russet*. The same principle rules in *blue-gray*, which is another and more correct name for *olive*, the blue being reflected more emphatically; also in *yellow-gray*, sometimes called *citrine*, in which the yellow is reflected more than the rest, etc. When the rays are all reflected rather feebly the effect must be a *dim-white*, or a very *light gray*, or *grayish white*.

3. It should be remembered that what seems to be a *violet* is not always formed by a single violet ray, but is very often in practice simply the union of blue with a smaller amount of red, just as a medium purple is the mixture of equal quantities of red and blue; in other words the blue and red are reflected and the other colors absorbed.* A violet-colored glass, if it transmitted

* It should be remembered that no red and blue pigments on earth can ever be

only pure violet rays, would be the coolest and most nerve-soothing medium that could be procured, but it always transmits many red and blue and sometimes violet rays. Manganese violet glass transmits almost entirely blue with less red. Orange very often is formed by the red and yellow combined, not by the simple orange-ray, and green by blue and yellow instead of the single green ray as in the spectrum, for Helmholtz has shown that such colors in the spectrum are not formed by the overlapping of two colors.

4. We thus see that while the *absorption* of colors is caused by chemical affinity, *reflection* is caused by chemical repulsion, or possibly, at times, by what might be called *mechanical repulsion*, or mere elasticity of atomic spring-work.

V. Transparency.

When a substance has such a strong chemical affinity for all the color-ethers as to be polarized and traversed in various directions by them, it may be said to be transparent.

If the colors are partly absorbed and partly transmitted, so that objects appear only dimly and imperfectly on the other side, it is translucent. It is settled beyond question by scientific experiments, that we cannot get the effect of light through our atmosphere without the incandescence of the countless particles or luminelles which float everywhere around us. The solar ethers and mere illuminated gases cannot give us the effect of light suited to our ordinary vision without the ignition of some solid particles. How, then, can glass transmit light to us as long as these luminelles must be partially prevented from passing through it in connection with the solar ethers? Perhaps by having an incandescence of its own atoms caused by the passage of these ethers. The polarized atoms of glass must take the place of the polarized atoms of the air in conveying the luminous ethers and transmitting them beyond.

found which will produce, when combined, an absolute violet like that of the sunlight, or even an indigo, as the violet combines a fine grade of blue with a red of the next upper scale, which is too fine to be visible if taken alone, and the indigo consists of blue modified slightly by a red tinge, which belongs also to the upper invisible scale rather than to the lower red.

The oxygen and nitrogen gases, as existing in their expanded condition in the air, cannot give us any proper amount of light even when ignited by the solar ethers, but it is necessary to have molecules or minute masses of chemically combined or solid matter to give us this effect, or in the absence of that to have matter like glass, crystal, etc., which, possessing a powerful affinity for the luminous ethers, can be permeated and to some extent perhaps ignited by them. If the atoms of glass thus assume a kind of an incandescent condition, the reader may ask why do they not burn the fingers when touching it? The careful reader of the foregoing has seen before now repeated examples of grades of heat which do not possess the burning character of the coarser style of incandescence produced by ordinary fire, as in the case of moonlight, or phosphorus, by means of which luminelles are ignited without appreciable heat. When the sun shines the luminous ethers extend in direct lines all the way to the sun that we may the better see it.

2. Prof. Tyndall says: "When a ray of light passes through a body without loss; in other words, when the waves are transmitted through the ether which surrounds the atoms of the body without sensibly imparting motion to the atoms themselves, the body is transparent. If motion is in any degree transferred from the ether to the atoms, in that degree is the body opaque." (*Notes on Light and Electricity, p. 76.*) As our scientific men have a conception of only this one ether, and that a stationary one, they must necessarily make it a pack-horse for a great many theories which would at least be considered very strange if applied to anything else. Thus light must move with all its trillions of waves a second, sweeping through the ether, without awaking any action of the atoms over which and around which it moves. Are atoms so stupidly inert as this and yet the home of all the amazing chemical forces? If hot light is thrown upon still water for many days we know a great change is taking place among the atoms, countless microzoa are generated, and putrefaction takes place, and yet its transparency continues through the whole. It is only the violent agitation which prevents the light from polarizing the atoms, such as in the twisted sweep of a vortex of water, or the effervescence of chemical action which at times interferes, at least in part with their trans-

parency. But the opticians and scientists, having only this one ether system to work with, must do the best they can, and, being desirous of explaining all things in some way, have bestowed upon it many shapes, many styles of power, many grades of fineness and coarseness of action, many thousands of colors, each of which must have its own special size of undulation without any known cause therefor, many degrees of swiftness and slowness of movement, being the universal steed for carrying not only light, but electricity, magnetism, gravitation, etc., as well as having many grades of elasticity, so that they may get some clue to the mysteries of refraction. Tyndall, in common with others, in his efforts to explain double refraction, says:—"The arrangement of the molecules of a substance carries with it an arrangement of the surrounding ether, which causes it to possess *different degrees of elasticity in different directions*" (p. 102). What should we think if any one should say that water when saturating certain bodies, such as a sponge for instance, is caused by the molecules of those bodies to have *different degrees of elasticity in different directions*, or that the air, when permeating a bundle of straw for instance, is liable to become more elastic horizontally than perpendicularly or obliquely? When the laws of force have been developed on a true basis, men of masterly abilities, like Tyndall, Faraday and others, will not be led into weak theories to explain the mysteries of things, and will be able to penetrate still more profoundly into the arcana of nature.

VI. Polarized Light.

1. I can only dwell briefly here on this intricate subject, the phenomena of which must be studied in works on optics. The principal trouble in studying these works, however, is that attempting to square everything with the mere undulatory theory, it is scarcely possible to get at the real philosophy of the matter, and it becomes a difficult thing to understand.

2. Light, when passing through certain substances such as tourmaline, or undergoing the ordinary simple refraction in certain substances, or of double refraction in others, or reflection at some one special angle, passes through a certain change in its character which is usually termed *polarization*, a term which is not very

appropriate, as all light must be propagated through polarized lines. In fact what is called polarized light, or heat, more commonly takes place in substances, the atoms of which resist in certain directions, the polarizing influence of light. The great Newton perceiving that such a substance as Iceland spar, from its double refracting powers, had two sides, considered that it must be polarized, something like a magnet which has its duplex poles, hence the name. I will mention briefly two or three varieties of polarization.

3. *Tourmaline.*—If thin plates of the crystal called tourmaline should be cut parallel to what is called the optic axis and placed side by side in the same direction, a ray of light striking them perpendicularly is able to pass through them both; but when one is placed at right angles with the other, the light after passing through the first plate has become so shorn of its usual power, that it is unable to penetrate and polarize the second plate in which the atomic lines move differently. This is illustrated by figs. 175 and 176. This seems to come from the fact that light cannot polarize and penetrate the atoms of either plate with the same freedom which it could those of ordinary glass, on account of the rigidity of their atomic lines in certain directions.



Fig. 175.

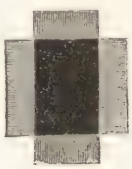


Fig. 176.

4. Polarization of light by both *Single Refraction* and *Reflection* is illustrated by fig. 172, in which is a bundle of plates of glass that should have 16 or more laminæ. *si* is the unpolarized ray of incidence, falling on the glass at *i* at an angle of 56° 45′; *if* is the reflected portion of the ray, and *ir* the refracted; *ir* being at right angles with *if*, and both having that changed character which is called *polarized.* In fact all reflected light includes a portion of polarized rays which vanish from view if we attempt to transmit them at certain angles through an object. Light from incandescent bodies, such as hot iron, etc., is polarized under a certain angle, but flame lights are unpolarized, and as the sunlight is unpolarized, Arago concluded that the rays which we receive must emanate principally from the luminous or flame-like gases of the solar atmosphere which hide the still brighter incandescent surface of the sun. All rays reflected at an angle of 53° (53° 11′)

from water, or 56¾° from glass, or 57° from rock crystal, or 68° from diamond, are polarized.

5. *Double Refraction.* Light passing through certain substances forms a double image, or is refracted in two quite different directions, and in different planes. Thus, fig. 177 represents a rhombohedric crystal of Iceland spar, upon which the light falls obliquely, making a double image of objects seen through it. The two lines of light constituting these two images



Fig. 177. Crystal of Iceland Spar.

are sometimes said to be *oppositely polarized,* but they are doubtless swept off into the diverging lines of atoms, a part of the rays going into one line which they are able to bend according to the usual laws of refraction, while the other atomic lines are rigid and cause the light to bend in their own direction. This point may be rendered more clear perhaps by means of fig. 178, which consists of lines of atoms whose spirillæ pass around them very diagonally. We will suppose that, by means of light, electricity, or some other force sweeping in the direction of 1, 2, the spirillæ of the layers of atoms in that direction should become so excited and potent as to draw the neighboring lines of atoms around in the direction of their own forces, or from 4 to 3. Such lines constitute *transverse diagonals,* as has been explained in Chapter Third, and doubtless have converse lines contiguous to them so that all the rays of light can be combined in the same direction. Suppose now, streams of solar ether should strike at 1 and 3, it is obvious that they would be refracted in different directions, the one not far from 2, and the other not far from 4, unless the atomic lines were so under the control of light as to yield en-



Fig. 178.

tirely to its direction, which is evidently not the case with tourmaline, Iceland spar, and various other crystals. If we should suppose a beam of solar ethers to approach at right angles to the line 3, 4, and strike at the points 1, 3, is it not evident that it would deflect the line 3, 4, much more than it would the line 1, 2, from striking the former *squarely*, and the latter only obliquely? In other words, may not the line 2, 4, be thrown so far around as to cause what is called an *extraordinary refraction*, while 1, 2, is thrown into merely an *ordinary refraction?* Fig. 179, which I take from Guillemin's Forces of Nature, will

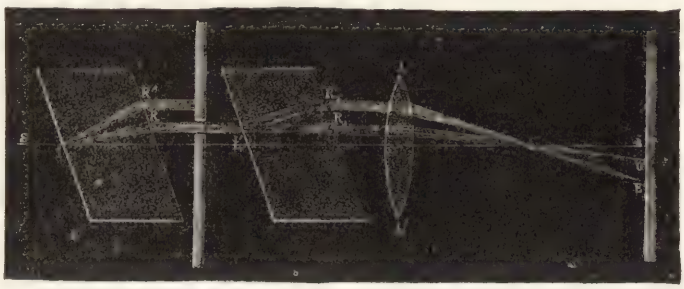


Fig. 179. The Polarizer and Analyzer.

illustrate this subject of double refraction and polarization. Light that has been doubly refracted by passing through one of these crystals, becomes so modified or shorn of some of its elements of power that it is said to be *polarized.* In the diagram, SI is a line of light which falls upon a crystal of Iceland Spar at I. It is there refracted into what is called the ordinary ray IR, and the extraordinary ray IR′. If we intercept one of the rays by a screen and pass the other through another crystal of Iceland Spar, it will be again divided into an ordinary ray I′R, and an extraordinary one I′R′. The lens LL′ is used to concentrate the light upon a screen, while the second crystal is made to revolve and show the variety of intensity and color which its different positions produce. The first crystal is called the *polarizer*, the second, the *analyzer*, from the fact that it analyzes the light, and shows what modifications have been produced by the polarizing influence of the first.

Jonathan Pereira, M.D., F.R.S., author of a work on Polarized Light, seemed to have hit very nearly upon a true con-

ception of the way the light is conducted through crystals in connection with atomic lines. I will quote his description of the refracting processes in connection with *selenite*, a crystallized hydrated sulphate of lime: "The optical structure of films or thin plates of selenite, having a thickness of from $\frac{1}{20}$ to $\frac{1}{60}$ of an inch, is very curious. In two rectangular directions they allow perpendicular rays of polarized light to traverse them unchanged: these directions are called the *neutral axes*. In two other directions, however, which form respectively angles of 45° with the neutral axes, these films have the property of double refraction. These directions are usually denominated *depolarizing axes;* but they might be more correctly termed *doubly refracting axes*. In order to render these properties more intelligible, suppose the structure of the film to be that represented by fig. 180, in which the film is seen to be crossed by two series of light lines or passages, the one perpendicular to the other. These are to represent the neutral axes. We may imagine that in these directions only can the ethereal molecules vibrate. A ray of incident polarized light, whose vibrations coincide with either of these lines, is transmitted through the film unchanged. But a ray of incident polarized light, whose vibrations form an angle of 45° with these lines, or, in other words, which coincide with the diagonals of the square spaces, suffers double refraction; that is, it is resolved into two vibrations, one parallel with *ab*, the other parallel with *cd*, and therefore the directions of the diagonals of the squares are called the *doubly refracting* or *depolarizing axes*. But the two resulting vibrations are not propagated, in these two rectangular directions, with equal velocity, the one suffering greater retardation than the other; so that the waves at their emergence are in different phases of vibration." The foregoing will be understood much more clearly by those who have become acquainted with the working of atoms in Chapter Third.

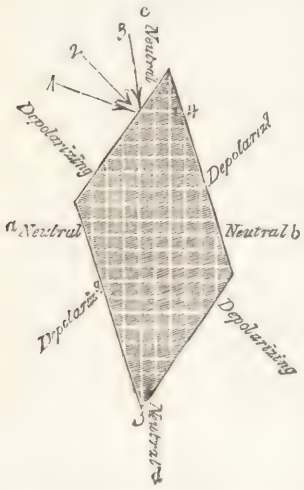


Fig. 180. Imaginary Structure of a Plate of Selenite.

There it may be seen just how atoms may combine into various rectangular, rhomboidal and other shapes with converse, transverse and paraverse lines of polarity, and that the transverse lines occur in one layer of atoms running parallel to each other, crossed at right angles by a similar layer of other atoms. It is then apparent just how rays of light, striking in the direction of arrow No. 2, fig. 180, would be about equally divided in the two atomic channels running towards 4 and 5, with the exception that refraction must somewhat modify these lines in direction. It is evident, too, that rays in the direction of arrow 1 must be projected in greater abundance towards 4 than 5, and thus make the former more luminous, while those in harmony with arrow 3 would pass more largely towards 5 than 4, thus making the latter more luminous and the former more feeble. It can easily be seen, then, just why such a crystal gradually rotated must constantly be changing its intensity of light until one dies out altogether. The unreasonable idea that a stationary ether retards the progress of light in one direction more than in the other, and this from its greater elasticity in different parts of the crystal or in different directions, should not be held for a moment, as long as double refraction can so easily be accounted for on principles in harmony with nature. Fig. 178 will also illustrate this point.

6. Polarized rays are the means of developing many beautiful combinations of color by means of refraction.

VII. The Undulatory Theory.

1. We have already seen in Chapter Second and elsewhere how utterly incompetent is the undulatory theory of light to account for many of the phenomena of light and color. That the light sweeps through cosmic ether and the earth's atmosphere is quite evident, and that both the ether and atmosphere must be subject to many undulations from the passing of comets, worlds, nebulous matter, and meteorological conditions, just as water is subject to waves when a vessel sweeps through it, is also evident; but what has that to do with the question of whether light is a substance or not a substance? The phenomena of interference, as well as other phenomena, may take place

from these atmospheric waves, and also, possibly, from the spiral waves of fluid ether as they emerge from a line of atoms. If the different colors are caused simply by waves of different size and frequency, as our theorists suppose, how is it that some waves are warm and exciting and expanding like the red, while others are cool and contracting like the blue? What power in heaven or earth can formulate waves of the exact size and rapidity to constitute red, and what to constitute violet, or the countless other tints and shades which must have their exact processes

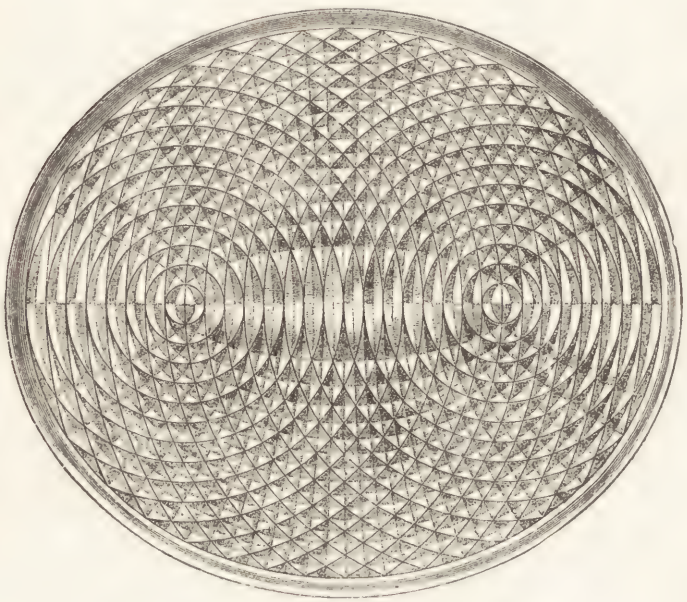


Fig. 181. Propagation and Reflection of Liquid Waves.

and their exact sizes kept up through all the millions of miles which constitute their path-way in space? By the etherio-atomic law we may see how the definite size of the spiral color-channels regulates the color, with just such a number of vibrations which can be continued from the distant stars to our earth. If the polarized lines become broken by means of atmospheric waves, they are formed again with lightning-speed, and so the light is uninterrupted.

2. Every boy knows that when different stones are thrown into the water near each other, the waves thus aroused more or

less impede or obliterate each other. He knows, too, that winds and counter currents will soon entirely destroy the forms of any waves which may be started, so far as any perceptible effect is concerned. If light and color depend upon such wave conditions which have to pass through the tempests of the upper sky, and the countless eddies which may be supposed to exist in the cosmic ether, the chance for illumination in this world would be rather uncertain. And yet scientists have striven to believe that because counterwaves of a gentle character can pass each other, and retain to a considerable extent their identity for a little while, so can luminous waves of ether start from the sun's surface, and, passing unimpaired through the boiling maëlstroms and tempests of the solar atmosphere, which are a thousand times more fierce than the maddest billows of the ocean, finally break in undisturbed peace on our earthly shores with every color effect occupying its exact proportions in the solar spectrum! The dynamic theorists seem to find comfort in the pretty experiment of the physicist, M. Weber, represented by fig. 181, which represents an elliptical dish of mercury. In one focus of its ellipse, a drop of the fluid is allowed to fall which, spreading over its calm surface in concentric waves, is reflected from the other end in a series of waves which encircle the other focus much as though a drop of the liquid had been allowed to fall there also. This wave movement in a quiet enclosed dish is quite a different thing from the stormy undulations which take place in the fields of space. Take even a tempest on the ocean, which is as nothing in comparison with what is constantly occurring in the sun's atmosphere, and what becomes of any regular system of undulations. Fig. 182 correctly represents a storm at sea. Fig. 183 gives a feeble representation of a solar cyclone, as observed by Secchi.

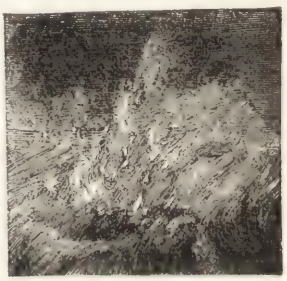


Fig. 182. Billows.

3. Those who insist that colors are formed by different sized waves of ether, exactly as sound is, should tell just how it is that 39,000 waves to an inch are formulated by the sun to produce the effect of red, or 44,000 to produce yellow, or

51,000 to produce blue, or 60,000 to produce dark violet. In music, the pitch of high or low tones depends upon short or long waves, and these depend upon a small or large tube in such instruments as flutes, whistles, etc., or upon small or large chords or other vibratory arrangements by which an exact size of undulations are produced. Perhaps our dynamists will yet decide that there is an infinite number of invisible whistles distributed all around the sun, or around all gas lights, or candles, to formulate waves of the right size for violet, and whistles of a still larger size for yellow, and so on. At any rate there is a wonderful precision and beauty of effect brought about by some process, and we ought to know how this can be done before being too positive in our theories.

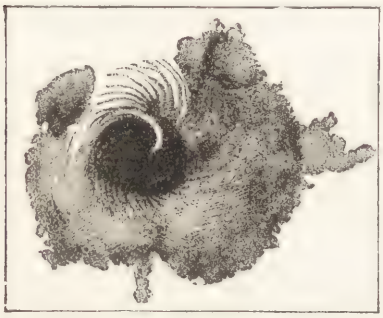


Fig. 183. A Solar Cyclone. May 5, 1857 (Secchi).

4. "Do not several sorts of rays," says Newton, "make vibrations of several bignesses which, according to their bignesses, excite sensations of several colors, much after the manner that the vibrations of the air, according to their bignesses, excite sensations of several sounds?" ("Optics, by Sir Isaac Newton, Kn't, 3d Edition, p. 320.") This remark by the great Newton has been re-echoed all along down through the two centuries since his day, and has a side of truth in it. But it should be understood that it is not entirely the wave action, or the up and down movement even in sounds, that makes its impression upon the mind as sound, but rather the rhythmic flow of electricities which become intensified at regular intervals by the condensation of air, as in fig. 184, which I copy from Guillemin's Forces of



Fig. 184. Undulations.

Nature. This electricity constitutes the very life or spirit, so to speak, of the air waves, and in the case of the telephone is

able to pass on through hundreds of miles of wire, unattended by its aerial body until it reaches its destination, when it again assumes its atmospheric clothing as a help-meet for reaching the ear so strongly as to affect human consciousness. Light also uses the air, not in the masses of atoms, which constitute waves, but in lines of single atoms, the different sized spirillæ of which constitute their distinctive *principles* of power as colors, When the sound-waves reach the ear, the air stops mainly at the tympanum, but the interior electrical ethers pass on to the membranous labyrinth and scala media, and there give the impression of sound. When light passes on to the eye, its conducting air lines stop at the cornea, but the luminous ether within passes on to the retina, and there impresses the pictures of the outward world.

5. Suppose, for the sake of argument, I should admit that light, heat, etc., are simply conditions of matter, mere non-entities, that result from the vibration of atoms or undulations of ethers: will my dynamic friend please inform me, what starts these vibrations, these undulations, into action? Everything must have a cause. Will he answer, that the sun's projectile power, brought about by chemical repulsion, gives the starting impulse? Truly, but we have seen in Chapter Fifth that all chemical repulsions as well as attractions are brought about by the flow of ethers in connection with atoms, or rather by the sweep of the finer through the coarser atoms, and we have seen in Chapter Second, that all power in the known material universe must be exerted in connection with fluidic forces, so that if we admit the undulatory theory, we must combine with it some winds of force which glide over or through the atmospheres and produce these undulations, thus forcing us at last to admit that in all electricities, colors, and other forces, there is a tangible something which constitutes the life of these forces.

6. The above remark makes it evident that what is called the dynamic (spirit-like) theory is really a grosser and more material conception of force than what is called the material theory, especially than the etherio-atomic law advocated in this work, which combines the truth of both sides of the question,—for what are waves themselves but matter, and what are the forces that project these waves but matter, acting in a much more crude

way than those amazingly fine ethers which, as we have seen by multitudinous facts, dash with lightning-speed through the spiral frame-work of atoms, so skillfully arranged as to be almost self-acting and spirit-like, the atoms drawing on and quickening the ethers, and the ethers firing up the atoms.

VIII. Summation of Points in Chromo–Philosophy.

1. *The knowledge of atoms and of the true principles of force greatly simplifies the explanation of optical phenomena, some of which can never be understood under the old theories.*

2. *Refraction consists in the jolting of the color ethers, which constitute light, out of their direct course by the striking of the spirillæ which convey them against a medium of different density. The fine, elastic spirillæ which carries the violet must necsssarily jolt its ether farther one side than the coarser spirilla which carries the red.*

3. *The Reflection of Light results from chemical repulsion. The Fraunhofer lines are the result of reflection, not of absorption, as usually supposed. Wrong theories prevent correct knowledge of the real potencies of color.*

4. *Absorption results from the chemical affinity of a substance for the colors which fall upon it, attended also with a sufficient amount of friction or of transverse atomic lines to prevent these colors from passing entirely through the substance.*

5. *Transparency comes from the fact that certain substances have such a chemical affinity for all the ignited color-ethers, as to draw them on with great power and transmit them beyond. Those substances whose atoms cannot be polarized by light are not transparent.*

6. *Polarization is a modification which light undergoes by certain angles of reflection and refraction. The word tends to mislead.*

7. *The theory of undulations is true so far as it concerns some of the phenomena of light, but it has nothing whatever to do with the formation of light, or with light as a substance.*

CHAPTER NINTH.

CHROMO-DYNAMICS, OR THE HIGHER GRADE LIGHTS AND FORCES.

I. Introductory Points.

1. At last we come to a triumphant series of facts in proof of the fine fluidic forces which constitute the inner *soul of things*, and also in corroboration of the etherio-atomic law. By their aid we may ascend toward the key-stone of the great archway of power, and deal with those more subtile laws and potencies of vegetable, animal, human, and even world-life which are revealed by the higher grades of light and color.

2. We have seen in Chapter Fifth, XXIII, that there are strong proofs of new and beautiful grades of light and color above that which impresses the outward vision. The following semi-prophetic and semi-philosophic passage from Professor Tyndall, hinting at the fact that man has powers which may yet be developed to see these higher colors, is already being verified by actual facts :—" If we allowed ourselves to accept for a moment that notion of gradual growth, amelioration and ascension implied by the term evolution, we might fairly conclude that there are stores of visual impressions awaiting man far greater than those of which he is now in possession. For example, Ritter discovered in 1801, that beyond the extreme violet of the spectrum, there is a vast efflux of rays which are totally useless as regards our present powers of vision." That many persons are able to see these colors, and that many more can be developed into this power, will be shown more fully in the next chapter, in which also rules will be laid down for attaining it. This chapter will be devoted principally to the explanation of Odic light and color, together with some of the marvelous forces connected with man and nature which are revealed thereby, while the next chapter will deal more especially with man.

II. Odic Light.

Baron Reichenbach, one of the most eminent scientists of Austria, made the discovery that a fine force issues from all known elements and substances, and appears in beautiful lights and colors which can be both seen and felt by persons whom he called *sensitives*. Having a spacious castle near Vienna, admirably adapted to his investigations, with an abundance of philosophical and chemical apparatus, and a private cabinet containing minerals and substances of every kind, he instituted thousands of experiments which extended over years of time and were conducted with a skill, a patience and a severe love of truth, which must make his name immortal, especially as connected with the great force of nature whose laws and phenomena he thus discovered. This subtile power he named Od, or Odic force, or Odylic force. As these fine invisible emanations constitute the basic principles of all other forces, and are forever working through all things, it is of vast moment to understand them, and it would seem almost criminal for our medical and other scientists to be so indifferent with reference to them, so long as human happiness and upbuilding are so greatly promoted by a knowledge of their laws. "Nature is eternal," says Reichenbach. "After a thousand million years will the odic light flow and shine as it does to-day, but the endeavors to overcome such a truth when it has once happily been found and disclosed, are paltry and poor." While such men as Berzelius, the great chemist of Stockholm, and Dr. Gregory of the Edinburgh University, and Dr. Elliotson, President of the Royal Chirurgical Society of London, and various other eminent thinkers and scientists, have freely admitted the greatness of the discovery of Reichenbach, too many even to this day *ignore*, or rather keep themselves ignorant of the whole matter. Even so well known a physician as Dr. Brown-Séquard sneers at the odic and other fine forces, and hosts follow in his track, thus riveting the shackles of prejudice more and more tightly about the people by their example. A body of rather superficial physicians of Vienna, anxious seemingly to combat Baron Reichenbach, rather than ascertain the exact truth, met together and had Miss Reichel, one of the sensitives whom Reichenbach had experimented with, attempt to describe the odic lights. They surrounded her, held

each of her hands, overpowered her by their own hostile atmosphere, mocked her and jeered at her, till the poor sensitive girl, in her anger and excitement, could do little or nothing to illustrate a great principle and then condemned her and the cause. It is well on the whole, perhaps, that they took such a course, otherwise we should not have had such a scathing and crushing exposure of their folly by Reichenbach as a warning to all similar cases of folly and ignorance. Dr. William B. Carpenter, the well known physiologist, considers Baron Reichenbach's experiments unreliable because he employed so many women in testing them. To this I would answer, 1st, that his experiments would more likely have been unreliable if he had *not* employed ladies freely in the matter, for woman's perception of the fine forces is as much superior to man's as man's ratiocinative talent is generally superior to woman's, and it is singular that so able an observer has overlooked this fact; 2dly, the Baron *did* employ numerous men who could see the Odic lights, including Prof. Endlicher, member of the Vienna Academy; Baron August von Oberlaender, Dr. Ragsky, Imperial Professor of Chemistry, Vienna; M. Karl Schuh, Natural Philosopher, Berlin; Dr. Huss, Physician in ordinary to the king of Sweden, and other gentlemen of scientific attainment. In all he experimented with about 60 persons, including many who were in sound health as well as many who were sick, having a greater number of ladies than gentlemen, as it should be in this class of researches, as the former were able to see longer flames and generally describe them more definitely than the latter. Some of the ladies, including the Baroness Natorp, Baroness von Augustine, and others, were persons of culture.

2. Aided by the knowledge of atoms, chromo-chemistry and chromo-Therapeutics, I think we may easily see the inner meaning and potencies of the odic colors, and ascertain their scientific bearing in a way which Reichenbach himself was unable to do without these aids. We should remember that every color has a certain exact style of power, no matter what the grade of fineness or coarseness may be; the odic blue and violet, like the visible blue and violet, being electrical, penetrating and cool in their nature, while the red either in a drug, or in the visible sunlight, or in the finer invisible odic rays, is a warming and exciting

principle ; in short, that every color must ever work after the same law, the only difference being that a color of a finer grade has a softer and more penetrating power than the same color of a coarser grade, and has also a greater influence on the finer mental forces, though not so direct an influence on the physical system. It is proper now to inquire into the nature of Odic light, as viewed by Reichenbach's sensitives. In some cases I shall condense his points, in others quote his exact language.

III. Nature of Odic Light and Color.

1. *Odic Light exhibits exactly the same laws and phenomena as the ordinary visible light.* " The odic light appears in five forms, producing different sensuous impressions, namely, in the condition of 1, incandescence ; 2, flame ; 3, threads, streaks and nebulæ ; 4, smoke ; 5, sparks." Prof. Endlicher and others, when the flame at the end of magnets was blown upon, saw it flicker about and grow larger just as ordinary flames do before the wind. Madame Kienesberger woke up in the night and seeing the iron window frame on fire with odic light, became alarmed, supposing it to be real fire. When she went to put it out it vanished, then reappeared when she lay down. In other words, when she was perfectly quiet and impressible, she saw the lights, but when moving around, her finer vision was interrupted. When a magnet became very weak there was " incandescence with no flame, only a little smoke," just as is the case with a smouldering fire. " Od shares with heat the peculiarity of two different conditions, one inert, slowly making its way through matter, a radiation. The od from magnets, crystals, human bodies, is felt instantaneously through a long suite of rooms." Odic light follows the same laws of refraction as common light, as it may be condensed and brought to a focus by a lens, and also the same laws of reflection, although the same substances that reflect ordinary light, are not always of the right grade to reflect odic light, as the latter is often able to pass through opaque bodies and make them transparent.

2. *An Odic Atmosphere or static ether must exist and bear the same relation to odic light as the ordinary atmosphere does to the ordinary light.* As the odic light is twice as fine in its vibrations as ordinary light, the odic atmosphere must also be

twice as fine, and its luminelles on the average, about twice as small as the ordinary luminelles. This is a deduction from the analogies of nature, and also from the fact ascertained by mathematicians, that the vibrations, which are twice as fine and rapid as those in the thermel, occur a little above the violet just about at the place where the odic thermel in the new color-octave would be expected to commence. In this finer atmosphere odic electricity, odic magnetism, odic thermism, as well as odic light and color exist with all their activities, as we shall see hereafter. To show that the odic light is not dependent upon our atmosphere, being in reality partially smothered by it, and that it must have its own peculiar atmospheric medium, I will quote an account which Reichenbach gives of his experiments with a magnet as viewed in the dark while the air is being withdrawn by an air pump:—"M. Firka, Johann Klaiber, and Mme. Kienesberger, also saw nothing at first: but when the air was half removed, they saw the contents of the bell jar become luminous, the magnet in the odylic glow. On further exhaustion, Klaiber saw the flame appear on both poles, first dull, then brighter as the air was removed more completely, increasing in vividness at every stroke of the piston, so that at last very bright flames flowed about under the bell jar. When the air was admitted, all light suddenly disappeared to the three observers, and it returned as soon as the pump had again been worked for a time." Mlle. Zinkell saw the flames beautifully brilliant, especially after the exhaustion of the air, one pole being blue, the other red, with a mixture of rainbow hues. Several others, including a blind man by the name of BOLLMAN, saw the same variations. These facts seem to indicate that there is a finer grade of oxygen and hydrogen and carbon, or some similar elements, to feed these flames, and a finer grade of gaseous or rather of ethereal matter as their basis, for those essences which are finer than the gases may be termed *ethers*.

3. *The Odic Light may appear in connection with all known objects, but more especially when these objects are under the action of the fine forces, such as electricity, magnetism, heat, light, etc.* I will quote the summing up of results obtained by a vast number of experiments, from Dr. Wm. Gregory's translation of Reichenbach's "Researches (Dynamics) on Magnetism, Electricity, etc.,

in their Relations to the Vital Force." (London Edition): "The time-honored observation that the magnet has a sensible action on the human organism is neither a lie, nor an imposture, nor a superstition, as many philosophers now-a-days erroneously suppose and declare it to be, but a well-founded fact, a physico-physiological law of nature which loudly calls on our attention. It is a tolerably easy thing and everywhere practical, to convince ourselves of the accuracy of this statement; for everywhere people may be found whose sleep is more or less disturbed by the moon, or who suffer from nervous disorders. Almost all of these perceive very distinctly the peculiar action of a magnet, when a pass is made with it from the head downwards. Even more numerous are the healthy and active persons who feel the magnet very vividly; many others feel it less distinctly; many hardly perceive it; and finally the majority do not perceive it at all. All those who perceive this effect, and who seem to amount to a fourth or a third of the people in this part of Europe, (Vienna), are here included under the general term 'Sensitives.' The perceptions of this action group themselves about the senses of touch and of sight; of touch, in the form of sensations of apparent coolness and warmth; of sight, in the form of luminous emanations, visible after remaining long in the dark, and flowing from the poles and sides of magnets. The power of exerting this action not only belongs to steel magnets as produced by art, or to the loadstone, but nature presents it in an infinite variety of cases. We have first the earth itself, the magnetism of which acts more or less strongly on sensitives. There is next the moon which acts by virtue of the same force on the earth, and of course, on sensitives. We have further all crystals, natural and artificial, which act in the line of their axes: also heat, friction, electricity, light, the solar and stellar rays, chemical action especially, organic vital activity, both that of plants and that of animals, especially that of man; finally the whole material universe. The cause of these phenomena is a peculiar force, existing in nature and embracing the universe, distinct from all known forces and here called ODYL" (p. 209).

5. *Length of Odic Flames.* These appeared of various sizes according to the intensity of the force by which they were produced and the clearness of vision possessed by the sensitive.

"Prof. Endlicher saw, on the poles of an electro-magnet, flames 40 inches high, unsteady, exhibiting a rich play of colors and ending above in a luminous smoke which rose to the ceiling and illuminated it. M. Delhez saw the flames of the same size, but did not distinguish the colors. The flames appeared to him darker below (red), brightest in the middle (yellow), and darker again above (blue). Mlle. Glaser saw, over the poles of the same electro-magnet, flames five feet high and smoke rising from them to the ceiling. The flames exhibited the most beautiful and varied play of colors, blue predominating over the northward, reddish yellow over the southward pole. Mlle. Zinkel saw the flame of the northward pole 40 inches high, that of the southward pole upwards of one foot in height. Both were colored, blue predominating in the former, red in the latter" (p. 342). An odic flame which appeared 16 inches long to Miss Glaser when issuing from a nine-bar horse-shoe magnet, was lengthened to 64 inches when a current from the electrical machine was applied to it. Miss Sturman while in a dark room perceived a "flame-like light" over a large rock crystal, "half the size of a hand, blue, passing into white above, remarkably different from the magnetic light," which had more of the yellow and red in it. She also said that "isolated filaments of a reddish color ran up in the upper part of the white." Streams of light several inches long would often be seen issuing from human fingers, and also from different parts of the body, from plants, and various other substances.

5. *Odic Polarization. As the solar ethers polarize the atoms of substances through which they pass, or follow the laws of substances already polarized as in many crystals, so do the odic forces either polarize bodies or sweep through atomic channels already polarized.* "It was discovered that every crystal presented two such points in which the force peculiarly resided. And these points lay diametrically opposite to each other in every crystal; *they were the poles of a primary axis of the crystal.* Both acted in the same way, but one much more strongly than the other, and with the distinction that from one appeared to issue a cool, from the other a softer, gently warm (seeming) current of air." (*Dr. Ashburner's Translation of Reichenbach*, p. 56.) Reichenbach uses the word *seeming* in this and other cases, not being sure that

when the sensitives so constantly told him that the fine influences were *warm* or *cold*, it could be anything but an apparent effect, as it would not move a thermometer. This comes from his being unaware of the fact, 1st, that there are different grades of heat and cold, the finer of which cannot be measured by coarse instruments, any more than meal can be measured in a coal seive; 2dly, the cold end of crystals and other polarized objects always emitted a *blue flame*, which as we have seen is constantly the effect of the cold and electrical current; 3dly, it always produced the cooling and contracting effect on the sensitive which comes from cold, while the other pole would produce the warming and exciting effect of heat and have red for its predominant color. These phenomena show the truth of many points already laid down in the previous part of this work. Reichenbach admits that the scientists of his day were unsettled as to which should be called the positive or negative end of a magnet, or a crystal, and being in doubt himself finally concluded to call the north end from which the blue rays emanate the *negative*, and the south or red end the *positive* pole, which is exactly wrong, as the more powerful external force, like the north pole, must be positive, and the weaker south pole negative. He finds the whole right side of the human body emitting the cold blue rays in predominance, and the left side the warm red rays, and so calls the former negative, the latter positive, which would seem still more improper than the terms as applied to a magnet. The power of a magnet comes especially from its *electrical currents* arranged in curves, and the positive principle of electricity is in the blue; if we are speaking of an object in which thermism rules, then the red constitutes the positive principle of power. It would be better to designate the different ends of a polarized substance as *electrical* and *thermal*, as these terms afford an exact meaning. The reader who has become familiar with the atomic theory will see just why a polarized substance must be warm at one end when it is cold at the other, as cold and heat move in exactly contrary directions. Reichenbach's sensitives found the small end of crystals warm and with thermal colors predominating, while the larger end was cold with blue predominant, the upper parts of plants and trees cold, the lower warm, etc. They could point out the main axis and its poles in crystals, by the

crystallic force itself, and in many crystals, especially such decided ones as "sulphuret of iron, selenite, fluor spar, heavy spar, sphene granite, etc., they would also discover other axes, the poles of which were much less strongly opposed." "Very frequently the main axis was not longer, but shorter, as in selenite."

IV. Warm and Cold Substances.

1. The sensitives in deciding what elements and compounds were od-warm and od-cold, and thus arriving at their interior chemical character more minutely than the chemists themselves have generally done, have proved irresistibly the importance of understanding these odic forces. Baron Reichenbach enumerates 172 elements and compounds of every kind which were determined by Mlle. Maix and Mlle. Reichel. Nearly every metal and alkaline substance were declared to be warm, potassium being at their head in this respect, while the electro-negatives generally, oxygen being at the head, and nearly every acid were declared to be cold, thus being a grand argument in favor of the correctness of the principles developed in the chapter, on Chromo-Chemistry, and of the laws of chemical affinity, as explained in Chapter Third, XXXVII. *Sulphuric acid*, next to oxygen is pronounced the coldest substance, and *water* is ranged on the cold side, but very feebly so. The table is far more correct as giving the chemical power of substances, than those giving what is called their *specific heat*, though, perhaps, presenting slight inaccuracies.

2. "Mlle. Reichel saw most metals red, almost as if red hot; some of them gave a white light, some a yellow. Copper, as we have seen, gave a green light. A delicate vaporous flame played over all, undulating backwards and forwards. More complex substances showed flame only at their points when crystallized. Otherwise they were either surrounded by luminous vapor, or were luminous in their mass as if red hot."

3. Reichenbach's sensitives constantly affirm that the sun's rays and ordinary fire are odically cold, but I think this effect, at least sometimes, comes from the thermo-electricity generated by the warm rays, as electricity is always developed by heat, especially as the temperature of sunlight was frequently measured by placing a metal plate in the sun, a few moments after which the

sensitive felt cold sensations, in other words, the cold was felt after the plate had had a little time to get warmed and charged by the light. The solar rays, as we have seen, must come equally through both the electrical and thermal portions of atmospheric atoms, although the electrical rays are doubtless more active in cold weather. The moon's rays were always pronounced warm. Its grade of heat is not coarse enough to be measured by an ordinary thermometer, but it is known to be the cause of nervous excitement in many sensitive organizations.

4. "The sensitive patient felt all radiations from electrified bodies cold. The feeling of cold increased rapidly, the faster I turned the plate of the machine, perceptible, not immediately, but several seconds later than the electrical charge." This is another confirmation of the statement so often made in this work, that *electricity acts on the law of cold.*

5. *The roots of plants are stated to be warm, and the ends of the leaves above cold.* The warm currents flow downward through the plant, the cold currents upward. Most *flowers* were found to be cool, but warm on their stem.

V. Influence of Solar and Lunar Rays.

1. *Sunlight.* Reichenbach put various plates in the sunlight and connected them by a wire 13 yards long with Mlle. Reichel, who held the point of the wire upward. The whole came through darkened rooms. In less than a minute after he had put the plates in the sunlight she saw a stream of light 10 or 12 inches high emerge from the wire. When his daughter stood in the sunlight in the place of the metal plate, the flame rose about 9 inches high. When he brought different metals from the sunlight into the darkened room, flames issued from them, especially from the sharp angles of the upper portions, green and blue from copper, clear white from gold and silver, dull white from tin, reddish white from zinc, etc.

2. *Objects charged with Sunlight.* I have already, in Chapter Sixth, XVII, shown the great power of substances charged with sunlight in healing, vitalizing or soothing the human system, including the discoveries of Dr. von Gerhardt, of Germany, which consists of sugar of milk, charged with the electrical rays by means of a prism, as a nervine and anti-spasmodic, and my own discov-

eries and inventions for securing the exquisite power of light, including a yellow-orange hollow lens, and a blue hollow lens, both of which when filled with water, and held in the light, answer as powerful lenses to focalize their respective rays upon the parts of the body externally, while the water within answers as a very soft, but subtile and penetrating influence to take internally, the former being a cerebral and nerve stimulant, vitalizing to the system, and laxative to the bowels, while the latter is cooling, quieting, anti-inflammatory, and soporific upon a system which is over-excitable and sleepless. This healing power of the sunlight comes not only from the ordinary visible colors, but from the odic colors which form the next color-octave above the visible range, for the blue glass transmits a large amount of odic rays, and even those which are still finer, while the yellow-orange glass transmits a portion of them also.

3. *Moonlight.* The sensitives always felt a warm current from objects that had been held in the moon, and saw a flame 10 inches high arise from the wire held in the moonlight with a plate at the outer end. Miss Maix felt an attractive force drawing her hand along the wire. The fact that the thermal influences of the moon, especially in the range of odic rays, overbalance the electrical rays of the same, seems remarkably confirmed by authorities quoted by Dr. Forbes Winslow, in his "Influence of Light," in which it is shown that especially in warm climates such diseases as diarrhœa, dysentery, hemorrhage, fevers, convulsions, nervous irritability, lunacy, etc., are worse in the full of the moon (or sometimes in the new moon), just as we might expect from predominance of yellow and red rays. "In India," says Dr. Winslow, "death has occasionally been known to arise from what is termed a *coup de lune*, or stroke of the moon; and in Egypt blindness has often been produced in persons who have imprudently fallen asleep with their faces exposed to intense lunar light." Blue glass or a blue veil would offset the exciting effects of moonlight, which in the negative condition of sleep, might at times be hurtful. Dormant conditions would be benefited by moonlight, and walking under the open moonlight, would in most cases bring much more benefit than harm.

VI. Magnetism and Odic Force.

1. *Points in which they differ.* Reichenbach enumerates thirty points in which Magnetism and Odyl differ. Some of these are as follows :—1st, Odyl is in most cases developed without the aid of magnetism, but magnetism never without odyl; 2dly, clouds over the sun's face arrest odyl, nothing can arrest magnetism ; 3dly, all bodies may be charged with odyl, only a few bodies with magnetism ; 4thly, odyl cannot attract iron filings, the magnet can ; 5thly, magnetism, according to Barlow, lingers near the surface of bodies, odyl penetrates through and through them, making them translucent, sometimes transparent; 6thly, the odic flame of a magnet is sometimes extinguished by the approach of a living being, while the magnetic action remains in force ; 7thly, an iron bar placed horizontally in the magnetic meridian will have its north end odically cold and its south end warm, but if placed with its north end inclined downward at an angle of 65°, which is the true magnetic dip in Vienna, and the best position for magnetic force, then its north pole will be odically warm and its south pole cold, in harmony with the ascending electricities, and contrary to the descending magnetic currents, for, as we have seen, there are currents of electricity which move directly upward as well as other currents which move northward, a fact which Reichenbach was not aware of.

2. *The Magnetic Poles.* The odic light is described as being especially brilliant at or near the poles of a magnet, and those who have clear vision can see a fringe-work of light over the whole surface. From the north pole a brilliant white light ascends which merges into delicate horizontal layers of red, yellow, green, and lastly blue, which last is so abundant as to constitute the predominating tint of the whole flame. From the south, or negative pole, a still more luminous light, but of much smaller dimensions, descends with white and colored rays in which the red predominates. The sensitives generally would speak of the negative (south) pole as being red, the middle of the magnet green, and the positive pole blue. The reason the south pole is more luminous is because the red and yellow predominate, while the north pole is stronger in its electrical currents and consequently more blue. We have seen that a keen grade of mag-

neto-electricity rules at the north pole, while the weaker chemico-electricity issues from the south pole, but the greatest power of the magnet is in the former which, sending its blue forces in one direction, must naturally send its affinitive red in the other direction.

VII. Opaque Bodies become Transparent.

Mlle. Atzmannsdorfer in the "state of somnambulism" saw "the glowing steel transparent almost like glass." "Friedrich Weidlich saw the flame in air two inches long. I then sank the magnet, lying in a glass basin, into water. The flame (for the most part) instantly disappeared, but he saw the magnet glowing and translucent, almost like the glass itself." "Metals in the odylic glow, appear to sensitives translucent, glowing through and through hollow balls." A mercantile gentleman of my acquaintance, in New York, can become so *en rapport* with these finer grades of light, as to be able to see through the human body as though it were made of glass. Here, then, is the philosophy of clear-seeing or clairvoyance, although many have the faculty so feebly developed that they are liable to commit mistakes.

VIII. Is Odyl an Imaginary Power?

1. Miss Nowotny's hand, while she was in an unconscious cataleptic condition, would be drawn and held to the magnet as would a piece of iron. Reichenbach once had a person go into another room from where his patient lay, and open a magnet of 90-pound sustaining power unknown to her. She immediately became uneasy and "complained that a magnet must be open somewhere, desiring that some one would look and relieve her from the pain. The armature was replaced without her knowledge, and she became quiet again."

2. M. Baumgartner, Professor of Physics, desiring to see if imagination affected Miss Nowotny in her judgment of the power of the magnet, took out a magnet in her presence, which he said was the strongest one in his collection. She however declared that it was the weakest of all the magnets, and "it seemed to her almost without influence." Baumgartner then laughed, and said "that it had been deprived of its magnetism, before leaving

home, by friction in the reverse direction," so that it was little else than a mere plain piece of iron.

3. The *charging of water* and other objects by means of the magnet, by human hands, held or darted near the water, by sunlight, by crystals and other substances, was believed in by the great chemist Berzelius, of Stockholm, by Dr. Gregory, of the Edinburgh University, by the eminent Dr. Elliotson of London, by Dr. Lutze, a physican of vast practice in Germany, and very many others. "Nothing could be more disagreeable," says Reichenbach, "than the reappearance of apparently so absurd a thing which all physicists and chemists are horrified even to hear of. But in spite of this, I could not refuse to admit what I saw before my eyes as often as I tried it; namely, that the girl always determined and unfailingly distinguished a magnetized glass of water from an unmagnetized. The force of facts cannot be combatted by any reasoning; I was compelled to recognize what I was by no means able to comprehend, but when I again met with the same, subsequently, in Misses Sturman, Maix, Reichel, Atzmannsdorfer, and others, and saw it in a still stronger degree, I gave up all doubt and opposition." Speaking of Reichenbach's many experiments on the magnetizing of water and other substances, Dr. Ashburner, a prominent British physician, says :—"The facts stated in this, have been exhibited in my house hundreds of times. Water has been magnetized with magnets, mesmerized with the fingers, by breathing, by the exertion of the will: over and over again, the tumblers in which these specifically treated quantities of water have been contained, have been instantly detected by somnambulists in the lucid state of sleep-waking, who have been in another room when the fluid was charged." "I have darted my hands 200 times over the surface of water, and have been told that the blue haziness has overflowed the tumbler. Several persons have said the same thing. I have placed a watch before me while I held the tips of my right hand fingers in the mouth of the decanter. Several lucid individuals have separately indicated the precise hight of the blue haze in the water at the same interval of time. A few minutes were sufficient to charge a quart decanter. All concur in the fact that the fluid sinks in the water. Is it, then, imponderable?"

4. In cool weather when the air is electrical, I can make one, two, or three strokes over tissue or other paper, and throwing it into the air within a foot of the wall, it will spring to it like a thing of life and cling there for hours, sometimes even for days. A mere stroke will make it attractive of everything around it, although it will generally repel another magnetized sheet, unless this sheet is magnetized with the same strokes as they lie together. Thousands of others can do the same thing, and some better than myself. I have made one magnetized newspaper lift and carry around another several times as large as itself. Now what is this power except the odic or vital force, combined with frictional electricity? It is not the ordinary ferro-magnetism, as it will not influence iron filings in the least, but must be this finer power thrown into attractive curves on the same general plan. It is sometimes called animal magnetism, which name, although it has been abused, is not very improper, and yet so well known a physician as Dr. Brown-Séquard, in a course of lectures delivered in Boston, almost questions its very existence. But too many of our medical scientists are dropping behind the age in ignoring these finer basic principles of things directly in the face of the fact, that thousands of persons can see the luminous pathways of these forces, as they emanate from human beings or other objects, and hundreds of thousands can feel their influence.

5. In the light of such facts, the folly of attributing these phenomena to imagination, prepossession of ideas, or mere subjective conditions, as do Drs. Braid, Carpenter, and so many others, is too apparent to need comment, and shows that the diseased subjective conditions are not with Reichenbach's sensitives who constantly prove their own points by stubborn facts, but with the doctors themselves who cling to their own theories in spite of all facts. In Dr. Carpenter's late lectures on "Mesmerism," etc., he uses the following language about Reichenbach, which is almost the only point that would give any trouble to one who is enlightened with regard to these fine forces, although the whole book would tend to mislead the ignorant:—"The fact which Von Reichenbach himself was honest enough to admit—that when a magnet was poised in a delicate balance, and the hand of a 'sensitive' was placed above or beneath it, the magnet was

never drawn towards the hand—ought to have convinced him that the force which attracted the 'sensitive's' hand to the magnet has nothing in common with physical attractions, whose action is invariably *reciprocal;* but that it was the product of her own conviction that she *must* thus approximate it." The sophistry of the above will appear, I think, from the following points: 1st, it is not the coarser forces of the magnet, which are known as magnetism, that act upon a sensitive person, but the finer odic and other forces which this magnetism wakens into action, so that the attraction is not direct but secondary. These finer forces have their attractive curves similar to the magnetic, which are sufficiently subtile to act on the nervous system, as will be shown in the next chapter; 2dly, it is probable that there is a slight secondary attraction of the magnet, though not enough to move a gross mass of iron. In the experiments with paper which I have just detailed, the paper itself will readily be attracted to a human being and will also attract sensitive human beings. 3dly, the assertion that "it was the product of her own conviction that she must approximate it," is overwhelmingly overthrown by several facts given by Reichenbach, Ashburner, etc., in some of which the subject was asleep or in an unconscious cataleptic fit, when the hand would be immediately drawn to the magnet and held rigidly to it. Dr. Ashburner speaks of persons who would be drawn six feet to the magnet, and of a boy who, if the armature was removed six feet off, would rush to it and fall asleep on the way. But multitudes of cases could be given in which human magnetism, crystals, and other objects have drawn unconscious subjects in the same way; 4thly, the experiments which I have just quoted with reference to Miss Nowotny and others, show that these forces operate entirely independent of one's consciousness. But the fact that Doctor Carpenter could overlook a whole volume of marvelous phenomena against his theory, and hitch to some little weak point shows the power of a "prepossession of ideas" in his own case quite similar to what he is fond of charging upon others. Wallace and Crookes having driven him into a close corner, he writes an article in Nature, Oct., 1877, in which, as he looks about for sympathizers, he makes the following remark:—"I asked my personal friend Prof. Hoffmann of Berlin, whether the doctrine (of Odic force) any longer finds support

among scientific men in Germany. His reply was a most emphatic negative; the doctrine, he said, being one which no man of science with whom he is acquainted would think worthy of the slightest attention." Is Prof. Hoffmann correct when he would thus indicate that German scientists are so deeply obscured in their perceptions that they utterly neglect these fine forces which are the vivifying power of all forces? I think there are many noble German thinkers who would consider this a slander upon their people.

VIII. Proof that Odic Light comprises Fluidic Forces.

1. Odic Light is manifested in flames which stream forth in various directions, and as the ordinary visible flames consist of luminous gases which are fluids, so must these odic flames consist of the finer fluids which we call *ethereal forces*. While none can see the inner essence of odyl, or magnetism, or electricity, or the solar ethers, yet the luminous pathway which their flow enkindles may be seen, and, judging by all analogies of the known external universe, we must consider that some marvelously swift fluidic force is passing. We have seen how the red odic fluid pours from the fingers of the left hand, and the blue odic fluid can be thrown from the right hand until a tumbler is filled to the top and made to overflow.

IX. Does Odic Light produce the Aurora Borealis?

Baron Reichenbach performed ingenious experiments to prove that odyl was the cause of the Aurora Borealis, but he seemed to forget that odic light, however intense, cannot possibly be seen by the ordinary vision, while the Northern Lights can be seen by everyone. He has skillfully shown that the magnet working in connection with a hollow iron globe, with its north and south pole at the respective poles of the globe, sends forth its blue and iridescent lights at the north, its red, etc., at the south, much the same as does the Aurora Borealis, and thereby achieves the following grand result; namely, by showing just how magnetism on a small scale can develope such colors in connection with the odic atmosphere, he shows just how the mightier play of a world's

concentrated magnetism at the poles may ignite the ordinary coarser atmosphere with its nebulous matter, and so cause a similar effect to the ordinary vision. See Chapter Fourth, IX, and X, 3, 4.

X. Terrestrial Dynamics.

1. In Chapter Fourth, X, we have seen that the law of heat awakens and propels thermo-electricity in two directions, namely, from the earth vertically, into the colder regions of the upper sky, and also from the warmer regions of the torrid and temperate zones towards the colder regions of the poles, the law of movement for electricity ever being from the warm to the cold. The sun's course, also, from east to west carries a line of luminous *force*, attended with some heat, westward, while in the east the tendency must be the other way. What, then, should be the colors that would naturally represent the main points of the compass, if we are to get at the real power of the earth's forces? Plainly blue for the north, with its kindred electrical colors on each side of it; red for the south, with its kindred thermal colors on each side of it; the luminous yellow for the west, and slight blue with some shadowy or gray elements for the east. This, we find, is exactly indicated by the odic lights and colors as discovered by Reichenbach's sensitives, although the Baron himself had not ascertained just why this arrangement in nature takes place. It being of vast importance that these great fundamental laws of force should be understood, it will be well to illustrate it at some length.

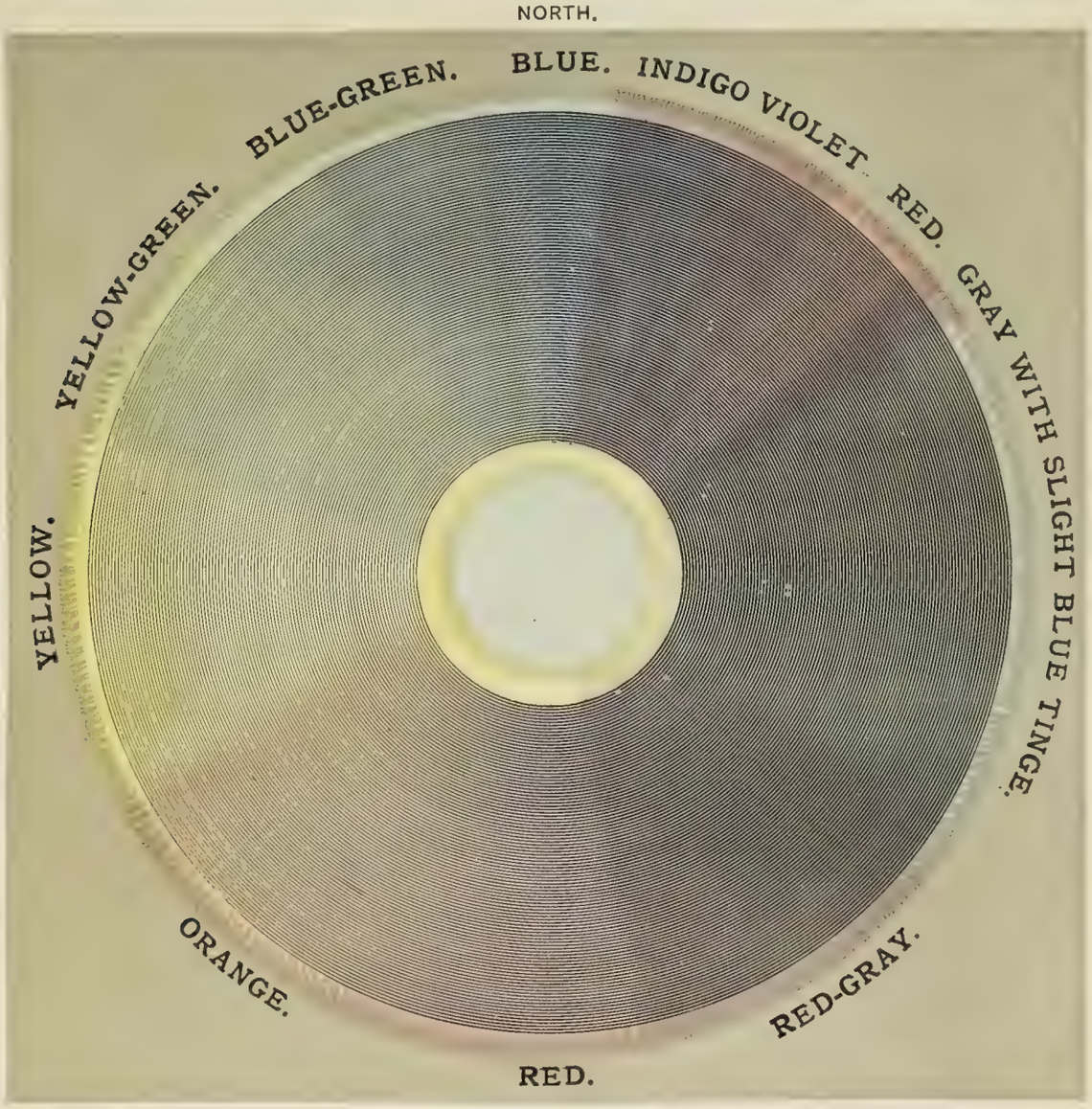
2. *Vertical Forces.* Let us commence first with electricity which moves from the earth vertically into the sky. If there is such a force of the cold principle, its manifestation must consist of the blue or violet as the leading element, while in the direction towards the centre of the earth the thermal colors, especially the red, must prevail. This we find to be the case with the odic colors, for when a bar magnet was placed vertically with the north pole upward, the blue would become more intense above and the red below; when this direction was inverted, both ends would be so contrary to the forces of nature that their colors would be almost smothered. "When the bar was placed verti-

cally, she (Miss Zinkel) saw it, contrary to all expectation, glowing with a bluish gray light at the upper end and with a whitish red below." "When both poles stood pointed upward, the northward (blue) flame was increased, the southward diminished." "Blue predominated at the northward, red at the southward pole. But still the flames arranged themselves into a most beautiful iris on each pole." On the lower portion of Plate III, may be seen the general plan of odic colors as they appear at each pole, arranged as closely as possible after Reichenbach's description, although, of course, incomparably less exquisite than the tints of nature. The following is a description of colors emanating from an electro-magnet as seen by Mme. Kienesberger:—"Close to the (north) pole, which stood vertically, appeared a red stratum, next to that a stratum of orange, then one of yellow, then one of green, one of light blue, one of dark blue, and lastly one of violet-blue (indigo and violet), above which arose a gray vapor. At the same time, the positive (south) pole exhibited close to the iron a blood red stratum (probably thermel), then light red, and above this orange, from which a thick heavy smoke rose to the ceiling. She described the appearance as one of extraordinary delicacy and splendor. Some weeks later, I made the same experiment with Mlle. Zinkel. She described the appearances in the same way as Mme. Kienesberger, being about equally sensitive, and added that each colored stratum was not uniform, but subdivided into smaller strata of different shades of color, so that the whole iris had the appearance of a great number of colored bands overlying each other. Beyond the violet she observed *a narrow streak of pure red*, in which the violet ended, after becoming gradually redder, and which passed above into smoke." Here we have the whole scale of odic colors described, together with the thermel and red of a still finer scale above the violet, or in other words the psychic thermel and red. Next to the magnet comes doubtless the heaviest and coarsest color which would naturally be called red by most persons, but which is probably odic thermel, with a very slight tinge of blue in it, while the more ethereal psychic thermel and red naturally come in at the top, being more refrangible than even the odic violet. On the south or warm pole most senitives saw only the red or red and yellow, but under the aid of a strong battery Mlle. Zinkel

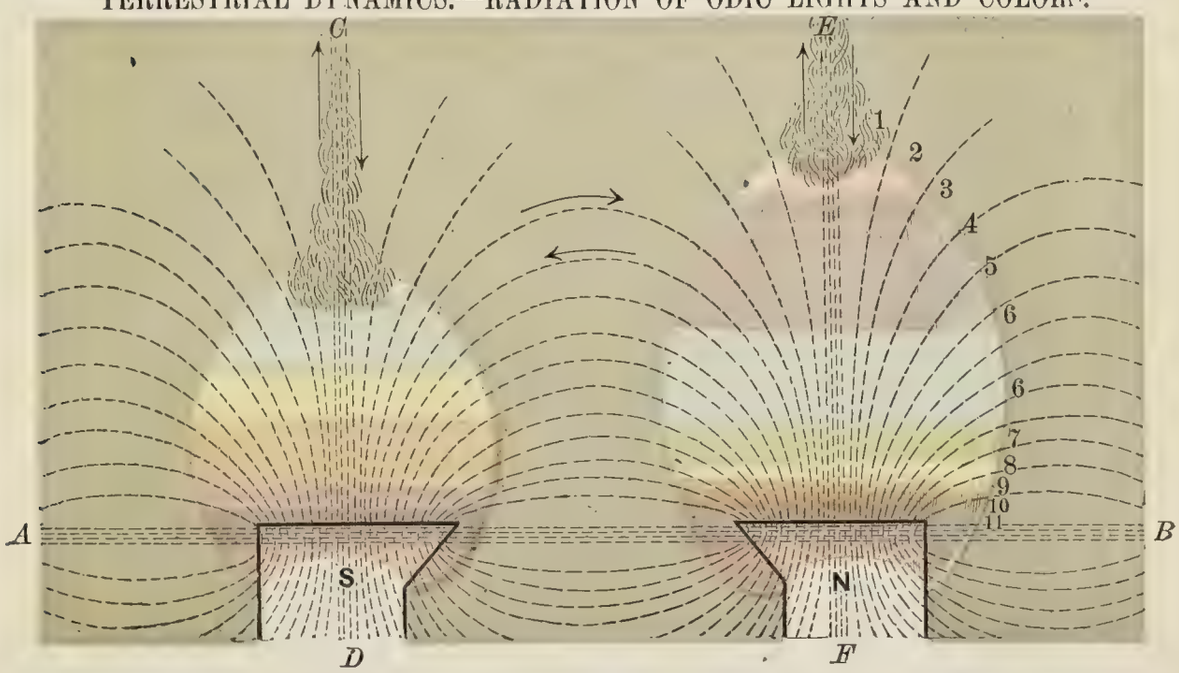
saw also the blue, and if her vision had been still clearer she would perhaps have seen the other colors also, although the electrical colors predominate at the north pole, and the thermel at the south pole. As we have seen, a weaker grade of electricity exists at the south pole, otherwise there could be no magnetic attraction there. If a piece of card board or glass should be laid upon the sides of the poles as they lie horizontally, and sprinkled with iron filings, the magnetic forces will arrange the filings into curves resembling the dotted lines in the plate, and if a sensitive look at these in the dark, they will coruscate like countless stars on account of the currents that are passing through them. The figures at the positive (north) pole represent colors as follows :— 1, gray-colored smoke; 2, psychic red; 3, psychic thermel; 4, violet (odic scale); 5, indigo; 6, 6, blue which predominates; 7, green; 8, yellow; 9, orange; 10, red; 11, thermel. N is north pole, S, south pole. It will be seen on reflection how admirable is the law by which the cold currents are made to go upward and thus prove cooling to the brains of human beings as they stand or sit, while the warm currents pass downward and thus help the feet. In the following paragraphs it will be shown how a person may lie in sleeping so as to get the advantage of still colder currents for the head and still warmer ones for the feet.

3. *Horizontal Forces.* The great forces of the earth caused by sunlight, heat, magnetism and electricity, and which are more nearly horizontal, may be arrived at by studying the following brilliant experiment of Baron Reichenbach, a beautiful illustration of which I have drawn up as nearly correct as possible, and had engraved in the circular figure of Plate III :—"I now tried the effect of *a circular surface or disc.* A disc of iron plate, 13.2 inches in diameter, was well flattened, and an iron wire folded into its circumference, so that a smooth, round, clean border, one twelfth of an inch thick, ran round it. It was suspended by a small hook in the middle, horizontally above the pole of the magnet, and could be fixed at any hight. I could now let it down on the northward pole of the magnet which stood vertically. * * I showed the disc to Mlle. Pauer. The odylic glow instantly spread over it. The colors were developed as might have been expected; on the upper centre, a blue spot, on the

BABBITT'S PRINCIPLES OF LIGHT AND COLOR.--PLATE III.



TERRESTRIAL DYNAMICS.—RADIATION OF ODIC LIGHTS AND COLORS.



ODIC FLAMES FROM THE POLES OF A HORSE-SHOE MAGNET.

The colors are not put on very accurately nor blended properly in these magnets, but the reader can consult page 434, with which and these colors he may be able to gain a fair conception of the radiations.

lower, in contact with the magnet, a red spot, both upwards of two inches in diameter. They passed into a surrounding yellowish zone, faintly tinged with red on the under, with green on the upper surface, and this again lost itself in a gray zone. This last continued to the border, where it was surrounded by a downy fringe of light, 0.6 of an inch thick and colored gray, blue, yellow and red in east, north, west and south respectively. In north-west, south-west, south-east, she saw respectively green, orange and gray-red (red-gray) ; in north-east violet with a short patch of red. These colors formed a continuous wreath of tints passing into each other, and thus a kind of a circular rainbow.

"I varied the experiment as follows with Mlle. Zinkel ; I connected with the poles of a Smee's voltaic battery of more than two and a half square feet of surface, the two surfaces of the disc ; the wires being only separated by its thickness, about one twenty-fifth of an inch. Immediately the observer saw around the upper centre of the disc connected with the silver, a spot of blue glow forming more than two inches in diameter. At the same time a similar red spot appeared on the under surface, connected with the zinc. No flame appeared. But the whole disc acquired a colored glow, not merely on its border, but over its surface, blue, yellow, red and gray, appearing respectively in the north, west, south and east positions, green in the north-west, etc., as before. The blue and red central spots each formed a kind of a star of innumerable points, or rather ray-like prolongations, stretching out toward the circumference, and uniformly exhibiting the color corresponding to the point of the compass toward which they were directed. On the rest of the surface the colors were arranged around the central spot in successive zones, so as to form a rainbow of parallel circles. A luminous web of fine downy fibres, enveloped the border of the disc. Besides this border, the whole surface was covered with a similar downy light or flame, rising as high as the thickness of a thin quill." (p. 424–426.) I have taken the liberty to put a slight tint of blue with the gray of the east as the sensitives frequently described the eastern portion of a soft bar of iron, or other objects as "*blue gray*," or "gray with traces of blue," etc. The second red coming next to the violet will be recognized by the reader as belonging to the third or psychic grade of colors.

This second red so often spoken of by the sensitives puzzled the Baron. He made a hollow globe of iron, inserted a magnet through it at its poles—found blue at the north, red at the south, and other colors exactly as already given in describing the *disc*, with a *very brilliant red* just below the violet of the north-east. "This remarkable red," he remarks, "was very brightly luminous and strongly red, much brighter than any part of the red on the south side of the ball. Red, therefore, occurred at both ends of the spectrum, on the one side from the yellow, on the other side from the blue. * * * Why this red, which in the ordinary spectrum appears only as violet in a part of the blue, stands forth independently in the odylic, is a fact, the causes of which can only be ascertained by further researches of another kind." Reichenbach did not seem to have the least idea that there could be any spectrum of colors higher than the odylic, for which reason the facts thus presented are perhaps all the more valuable, as they are not warped by any theories, or rather are given contrary to his suppositions in the matter.

4. *Miscellaneous Points.* The principal direction of the earth's electricities as signified by the foregoing and many other experiments is north as shown by the blue, somewhat north-east as shown by the still finer violet, somewhat west of north as signified by the blue-green, and upward as signified generally by the intensifying of the blue and violet principles when the magnet is held vertically. Mlle. Pauer saw the soft iron bar give out "to the south yellowish red, vertically upward, pale yellow (at a certain distance pale bluish), to the north blue." Here it is said that pale yellow was the appearance which presented itself on the upward pole at a certain distance from the object, which may be true when the sun is high in the sky and throwing its luminous rays downward, but most experiments showed the power of the blue in that direction, though a more luminous and feeble blue than that at the north.

XI. Terrestrial Dynamics in Human Life.

1. *How Applied to Human Life.* Thus far we have ascertained how the great forces of the earth move—in what direction the electricities play, and whither the thermal rays tend. We

have also ascended one grade higher on the ladder of power than ordinary electricity, or magnetism, or thermism, or the visible rays of sunlight, even into the range of odic lights, colors and forces, which open up a new heaven and a new earth to man. We have seen that whatever may be the direct power of light, heat or electricity upon the human system, they call into action those finer interior potencies which almost take hold upon the very springs of life itself. In all this we have not been building upon dreams or mere theories, but upon an array of carefully established facts which to a candid and thorough mind should be irresistible.

2. *Physiological Adaptation.* The first question to be considered is—how shall we receive these terrestrial forces in a way best to harmonize with the natural constitution of the human system? One thing is pre-eminently plain at the start, which is that the head is the warmest, and the feet the coldest part of the body, while nearly every inharmonious condition tends to bring too much blood or nervous action to the brain, and perhaps viscera, while the extremities are left too cold and dormant. For this reason the earth's magnetisms and electricities, which belong to the cooling category of forces, should move from the feet towards the head, while the opposite thermal forces should pass towards the feet; consequently in sleeping, the head should be towards the north or north-east to receive the blue or violet forming currents, and the feet towards the south, or south-west to receive the warm currents signified by the red and orange. Another important matter to observe is to have the forces of the earth flow harmoniously with the same kind of forces in the human body. Thus it has been ascertained repeatedly that the cooling blue emanations flow from the whole right side of the head, arms and body, while the red emanations flow from the whole left side. In other words the electrical currents enter on the left side, and issue from the right side, while the warm currents must necessarily flow in the opposite direction. This was repeatedly demonstrated by the sensitives. To show that odic force was stronger than that developed by the earth's magnetism and illustrate the polarity of the body, I quote the following:—"I caused Mlle. Zinkel to hold between two fingers and *conformably* in the meridian a four-inch needle, not strongly

magnetic. When I held the southward pole in my right finger points, the blue northward became three times as long as before. This showed the feebleness of the needle in comparison with my hand. But when I held the same pole with the fingers of my left hand, the blue flame disappeared, and the red flame took its place. When I made the experiment at the other end of the needle, with my left fingers on the negative (positive) pole, the red flame of the opposite pole became brighter and three times as long as before. But when I applied the fingers of my right hand to the same negative pole, the red flame disappeared and was replaced by a blue one." Such being the case it must be evident that when the earth's electrical currents strike the right side of a sensitive person, it must conflict with the natural currents of the system and give distress. In illustration suppose a person should lie on his back with his head to the west. The northward electrical and magnetic currents, which are strongest, would then strike him in the right side, and, conflicting with the natural electricities which move in the other direction would tend toward inharmony. Besides this the yellow forming currents which flow westward must be highly exciting to the brain, and thus the west-east position in sleeping must be doubly bad. In proof of this and the first physiological law, I will now quote some examples from Reichenbach, especially as even persons who are not sufficiently sensitive to perceive the difference must in the long run be injured by violating these simple laws of nature, while persons of active brains and susceptible nerves must at times be affected ruinously by such violation, for the finer the force, the more deeply does it work either for good or ill.

3. "*M. Schmidt*, Surgeon in Vienna, had experienced a chill in his right arm, while traveling on a railway, and had for some time suffered in consequence, from severe rheumatism in the limb, with most painful spasms from the shoulder to the fingers. His physician employed the magnet, which quickly subdued the spasms ; but they always returned. I found him lying with his head towards the south. In consequence of my remarks on this, he was so placed as to lie in the magnetic meridian, with his head towards the north. As soon as he came into this position he expressed instantly feelings of satisfaction, and declared

that he felt, generally, refreshed in a singular degree. The previously existing chilliness and rigors were instantly exchanged for an agreeable uniform warm temperature; he felt the strokes of the magnet now beyond comparison more agreeably cooling and beneficial than before; and before I left him, the rigid arm and fingers had become movable, while the pain entirely disappeared."

4. *Mlle. Nowotny* had intuitively sought out the north and south position, that is, with the head to the north and feet to the south. She insisted upon occupying this position, and "it had been necessary to remove a brick stove to allow of her wish being gratified." Baron Reichenbach had much trouble in persuading her to lie for a little while with her head to the south. "Before long she began to complain. She felt uncomfortable and restless, became flushed, and her pulse became more frequent and fuller; a rush of blood to the head increased the headache, and very soon the disagreeable sensations affected the stomach, producing nausea. We hastened to change the position of the bedstead on which she lay, but stopped when we had turned it round to the extent of a quadrant, her head being now towards the west. Of course she now lay in the plane of a magnetic parallel. This direction was to the patient absolutely intolerable, far more disagreeable than the former, that, namely, from the south to north. This was at half past 10 A. M. She was afraid, from her sensations, that she would soon faint or become insensible if kept in this position, and entreated to be quickly removed from it. She was now placed in her own original position, her head towards the north. Instantly, all the painful sensations yielded, and in a few minutes they had so completely vanished, that she was again quite cheerful." On another day the same experiments were tried with still severer results, causing "shuddering; restlessness; flushing of the face; acceleration of the pulse; a rush of blood to the head; headache; and finally pain of stomach, ringing in the ears, failure of the senses, and the approach of fainting. We were compelled to bring her in haste into the north and south position, in order to restore her, otherwise she would have fallen from the chair. When this was done, the rapidity with which all these painful sensations disappeared was astonishing." The east and west

position also affected her severely, but more mildly than the others.

5. *Mlle. Sturmann*, of the Clinical Hospital of the University of Vienna, lay in the west-east position. When she was turned to the north-south position, everything was changed instantly. "The patient immediately gave signs of satisfaction; the previous restlessness left her; a painful smarting of the eyes, from which she had recently suffered, disappeared. Instead of the intolerable heat which had before tormented her, she felt refreshing coolness, and a general sense of relief pervaded her frame while we observed her. There followed a night of such quiet refreshing sleep as she had not for a long time enjoyed. From that time forward her bed was kept in the same position which she earnestly entreated." When she was turned to the south-north position all her bad symptoms returned, and these were removed by turning her head northward again.

6. *Mlles. Maix, Reichel* and *Atzmannsdorfer* found the same kind of improvement in the direction of north and south, the west to east position being the worst. *M. Schuh* had the singular habit of turning his head to the foot of the bed for his morning nap which was much more refreshing than all the rest of his sleep. "When he failed to obtain this he felt wearied the whole succeeding day." His bed was found to be in the south-north position. After he had turned it so that the head came north, he felt no need of the morning nap, and forever abandoned it, as his sleep was good and strengthening.

7. Another fact of vast importance with reference to sensitive patients was ascertained in these experiments, which is that *when they lay in directions contrary to the harmonious flow of forces such as the south-north or west-east position, all use of medicines or of the magnet for mitigating disease seemed to be either powerless or to have a very perverted action, giving distress rather than relief.* Ignorance of this fact has worked countless blunders in the medical world, and many mistakes in the effort to acquire a knowledge of the fine forces. Is it not criminal for physicians to neglect to inquire into these momentous facts, and thereby allow nervous patients and those of active brains and over-heated systems to languish and die from want of knowledge

of these resistless forces? To tell people that it is important to sleep with the head to the north is often to provoke a smile of incredulity. There is no power that knocks them down when they sleep in other directions, and so they stupidly think that one direction is as good as another. There is a force that is viewless and voiceless, and intangible, and a million times softer than the evening breeze. Does that show that it is weak? It is vastly swifter than lightning, wafts all worlds on its bosom, and holds the entire universe in immutable chains, so that even a grain of dust cannot stir without its permission. It is called gravitation. Then kindling up all things are these glories of light and color, some of which are so exquisite as to conceal themselves from common eyes, and yet they are mighty in controlling human life, and their radiance reveals the secret hidings of power. Although many persons may have that sturdy and coarser physical power which does not take direct cognizance of odic lights and forces, yet a long continued violation of their laws must demand their penalty. For this reason I have striven to make the laws underlying these forces clear to my readers and have clinched them with this extensive array of facts. I could give many more facts from acquaintances of mine, some of whom say they cannot sleep well at all except with the head to the north, or somewhere near the north. When I have been in strange places and have found myself tossing in bed for hours without being able to sleep, I have noticed that I had been lying with the head to the south or west. On changing my bed to the north or north east I would get to sleep in a short time, as the brain pressure would be gone. I can sleep quite comfortably also with the head to the east. I have taken pains in these remarks to show the philosophy of these directions, so that, aside from the facts, people may not consider it a whim. When speaking to incredulous friends and urging them to change the position of their beds, I have referred them to the fact that the cold magnetic forces of the earth as they move northward, give the magnetic needle its direction, and as the head, being charged with blood, has need of the cooling element, and as I have fortified my theories with facts, I have not had much difficulty in getting thoughtful people to admit the force of the argument.

8. *Position in Sitting.* When it is convenient it is better to sit with the back to the north or north-east, or at least to the east, in preference to the other directions, especially when taking a sun bath, or receiving any kind of treatment. "All these patients," says Reichenbach, "now recollected how painful it had always been to them to remain for any length of time in the church. All Roman Catholic churches are built from west to east, so that the members of the congregation find themselves when opposite the altar, in the position from west to east; consequently in that position, which is to sensitive persons, of all others, the most intolerable. In fact they often fainted in that position and had to be carried out. At a later period Mlle. Nowotny could not even bear to walk in the street, or in the garden, in the direction from west to east, if her walk lasted but for a short time" (p. 71). There is no danger that people in general, especially in good health, will attain to any such extreme sensitiveness as this, but I quote it to illustrate a principle.

9. *Nervous Diseases.* Considering the great ignorance on this subject, and that there is scarcely a family but has one or more members afflicted with distressing nervous symptoms of some kind, the sweetness of womanhood and the dignity of manhood being too often turned to gall even when they are not innately hateful, would it not be well to turn for instruction and help to this beautiful radiation of light, including the finer as well as the coarser grades which seem to reach up more or less into the soul forces themselves, and attune them to greater harmony? *

10. *The North East Position.* I would recommend a direction for sleeping not exactly north-east, but some 30° east of north, or about one third of the way from the north to the east, as this would enable a person to receive the strong and cool northward currents over the head and upper body, and also some

* It occurred to me that the portly, rubicund Englishman should be more free from nervousness than ourselves, but after spending a year in their midst, I am not quite sure of this. At a private residence in London, I saw a lady rush screaming from the dinner table because some one remarked that there was a Sabbath school near by and it would be well for her to become a teacher in it. People greatly need more exercise in the sunshine and pure air, more calming of the brain forces by the blue and violet principles, and a more stern use of their will power to gain self-command.

portion of the eastern electricities. By looking at the circular plate it will be seen that this would bring the head somewhat into the violet odic rays, which are above all soothing to the nervous system.

A scientific gentleman, possessing exact habits of observation, has informed me that he sleeps better with head rather to the north-east than to the north, and for years I have slept with great comfort at an angle of 30° or more east of north. The main streets of New York inclining a little to the north-east and south-west are a very good model in this respect for a city. Reichenbach mentions a single case with whom the north-east position for the head disagreed, but the full north-east position, or a little farther around, would bring the head into a grade of red, and this of course is wrong. The advantages in laying out a city with streets which run as above recommended, east of north and west of south in one direction, and at right angles to these in the other, are as follows :

The beds can be in the best position and still be in harmony with the form of the rooms.

The sunlight can reach all sides of a house each day with its healing and purifying influence.

Every street at the different times of the day will have a sunny side for street walkers in the cooler seasons, and a shady side for use in the hotter seasons.

The front, back and side door-yards will each receive the sun some portion of every sunny day.

XII. Miscellaneous Points.

1. *The Rapidity of Vegetable Growth* seems to depend much upon the intensity of its odic emanations as signified by the following, witnessed by Mlle. Maix:—"The *Calla* was most powerful, the *Aloe* the least powerful, so that it appeared as if the strength of the influence kept pace with the rapidity of the plant's growth. The rapid growing *Calla* produced a sensation greatly more vivid than the sluggish *Aloe*, notwithstanding the great size of the latter; while the *Pelargonium moschatum* stood, in every respect, between the others" (p. 188).

2. *Hunger* and *weakness* cause feeble odic lights, and the

odic light emanating from the pit of the stomach is weakened during a pain. The *emanations* are more positive and brilliant during the positive conditions of health and strength.

3. *Sleep.* The state of shadow and darkness having a more quiet and negative grade of odic force than that which is aroused into action by the sunlight, renders night a more favorable time for sleep than the day-time.

4. The odic force from a powerful magnet could sometimes be *felt at a distance of several hundred feet* where no air was stirring; the cooling effect of sulphur was felt 120 feet off, the warming effect of a copper plate of four square feet, 93 feet. An iron plate of 6 square feet gave warmth at a distance of 147 feet, and lead foil do., 75 feet.

5. Odic Light was seen to be more ethereal and pure when strained through glass, in harmony with what has been stated in Chromo Therapeutics.

XIII. Summation of Points in Chromo-Dynamics.

1. *This chapter demonstrates from actual facts, the existence of fluidic ethereal forces, and this is corroborative of the etherio-atomic law.*

2. *It demonstrates that other grades of color exist besides those we usually see.*

3. *The existence of Odic Light was demonstrated by years of experimentation by Baron Reichenbach whose thoroughness of method has never been surpassed, if equaled, in the records of scientific research.*

4. *Aided by a knowledge of atoms and chromo-chemistry we may perceive the real potencies of these interior forces.*

5. *Odic Light manifests the same phenomena of incandescence, flame, sparks, smoke, etc., as ordinary light, and must work in connection with a fine atmosphere of its own, just as common light works in connection with the atmosphere which we breathe.*

6. *Odic Force emanates from all known objects and manifests itself in the form of Odic Light when these objects are kindled into action by sunlight, moonlight, electricity, heat, magnetism, friction, etc.*

7. *Odic Flames have been witnessed of various lengths, from the fraction of an inch to about 6 feet.*

8. *Odic Force follows the law of polarity, and objects like crystals,*

magnets, etc., generally have one end more electrical, the other more thermal.

9. *Electrical or Cold Objects and forces were seen to be blue or bluish in their radiations, while most metals and the warmer objects had an extensive amount of red.*

10. *The Solar Rays will charge objects so that streams of odic light will flow from them and continue to do so for some time after the objects are removed. The Lunar Rays are somewhat exciting, especially at the full moon.*

11. *Magnetism, besides being coarser, differs from odic light in many points. The poles of a magnet, of crystals, and the ends of the fingers are especially luminous with Odyl.*

12. *The proof that Odic Light is not imaginary, is the fact that so many see and describe it in the same way, and can point out unerringly water and other objects which have been charged with it.*

13. *Opaque bodies are sometimes made transparent by Odic Light.*

14. *Odyl is shown to be a material emanation.*

15. *The Vertical Forces of the earth are cold and bluish upward, warm and reddish downward.*

16. *The horizontal forces of the earth are electrical in the following directions: 1st, in the direction of the north magnetic pole in which the thermo-electrical and magnetic forces predominate, and show a deep blue influence; 2dly, east of north in which the indigo, then the violet forces, rule; 3dly, west of north where the blue-green forces move, and lastly in the east, where a feeble electricity rules in the slight bluish gray. They are thermal in the south where the red is predominant, in the west where yellow forces rule, and in the south-west, south-east and north of west, in which the orange, red-gray and yellow-green respectively manifest themselves.*

17. *Physiology and many experiments show that in sleeping the head should be at the north or somewhat north-east, and the feet in the opposite direction to harmonize with the earth's cold and warm forces. Medical treatment is shown to be inefficacious or injurious with sensitive patients whose position is at discord with the earth's forces.*

18. *The direction of the streets of a city should be regulated with reference to lights, shadows and terrestrial dynamics.*

CHAPTER TENTH.

CHROMO-MENTALISM.

I. Mentality.

In considering the laws of visible light and color, we have been dwelling in nature's outer temple ; in unfolding the mysterious workings of the odic light and color, we have entered the vestibule of the inner, and have taken the first steps into the citadel of life itself. Shall we dare to open still another door farther within than the mere realms of physical life ? Nay, shall we approach the holy of holies and stand in the very presence chamber of Mind ? We gaze in awe upon a great temple, a mountain, an ocean, a world. But Intellect is greater than these, for it can measure and weigh the worlds themselves, and sweep a thousand times beyond their orbits. Intellect, or Mind, is the soul manifesting through the body, and the soul being a spark of the Infinity is itself infinite.

II. Beauty of the Fine Forces.

I have been doubly impressed with the wonders of the Mind from the resplendent character of the forces which it uses, as manifested by a grade of light and color still finer than the odic, which may be termed the *psychic* or *third grade colors.* This, of course, is constituted of vibrations which are twice as fine as the odic or four times as fine as those of the ordinary light. In the year 1870 I commenced cultivating, in a dark room and with closed eyes, my interior vision, and in a few weeks or months was able to see those glories of light and color which no tongue can describe or intellect conceive of, unless they have been seen. Do you say it was imagination ? But no mere imagination can come half way to the reality of these things. Imagination itself must construct the warp and woof of its fabrics out of realities. The finest mosaic work and the

most exquisite works of art are but trash by the side of these interior splendors. I have witnessed what have been called marvelous decorations in museums and palaces of Europe, but none of them are fit to be spoken of in comparison with these peerless colors and exquisite forms. Imagination is generally more dim and shadowy than realities, but these colors were so much more brilliant and intense and yet soft than any colors of the outer world, that when I opened my eyes upon the sky and earth around me after seeing these, they seemed almost colorless and dim and feeble. The sky no longer seemed blue, but blue gray, and a poor blue-gray at that. I saw so many grades of violet, and thermel, and indigo of wonderful depth, and blue, and red, and yellow, and orange, more brilliant than the sun, seemingly hundreds of different tints, hues, and shades which could be easily distinguished apart, that at first I thought there must be different colors from any that are usually visible, but finally concluded that we have the basic principles of all colors in external nature, though so feeble comparatively, that we scarcely know what color is. Sometimes fountains of light would pour toward me from luminous centers merging into all the iridescent splendors on their way. Sometimes radiations would flow out from me and become lost to view in the distance. More generally flashing streams of light would move to and fro in straight lines, though sometimes fluidic emanations would sweep around in the curves of a parabola as in a fountain. What was more marvelous than almost anything else was the infinite millions of radiations, emanations and luminous currents which at times I would see streaming *from* and *into* and *through* all things, and filling all the surrounding space with coruscations and lightning activities. I believe that if the amazing streams of forces which sweep in all directions could be suddenly revealed to all people, many would go wild with fright for fear they should be dashed to pieces. Several times I have seen untold millions of polarized particles of vari-colored luminous matter, changing their lines of polarity scores of times a second, like an infinite kaleidoscope, and yet never falling into disorder, for when a particle left one line it would immediately form in exact order in the next line. For sometime I was much puzzled to know what these could be, but it seems quite probable that they were the luminelles which fill

the whole atmosphere and constitute under the solar power the basis of light. The dust of iron filings, as seen by the coarser odic light by Mlles. Reichel and Zinkel, while animated by the magnet, caused exclamations of surprise at the extraordinary beauty. Mlle. Zinkel "saw on the glass plate millions of little brilliant stars arranged in curved lines. She testified the greatest pleasure when, by gently tapping the plate, I caused the stars to move and leap about. The whole of the northward half had a predominating blue light, beautifully variegated with all other colors; on the southward half an equally variegated and beautiful red light prevailed" (p. 357). At the present writing, I have forgotten the exact direction of these lines, but think they were either perpendicular or slightly oblique to the earth's surface. They were seen generally at night between 9 and 11 o'clock, and may have been excited into the fine grade of luminosity by the earth's radiations.

III. This Finer Vision Exalts One's Conceptions.

1. These finer interior views of nature and her forces show us that *there are universes within universes*, and that the condition of things which we inhabit is not the real universe, but the mere shadowy outer shell of being, while the real cosmos is so much more intense and swift and powerful than the grosser grade of materiality around us that the latter compares with the former somewhat as a mist compares with a solid substance. And yet there are those who think that this lower universe is all that there is for man, while the sublimer realms of existence are to go to waste as a worthless thing. Even so low a grade of being as a chrysalis can awaken from its coffin and move off into the sunlight, but man standing upon the very pinnacle of nature, and the natural master of its domains, must vanish in eternal oblivion, according to these theorists, before he has fairly entered upon the possibilities of things around him.

2. After viewing these wonderfully refined lights, colors, and forms, my ideals of beauty and perfection became greatly improved, and my conception of the possibilities of man and nature grew far broader. The gorgeous transformation scenes of the New York, Paris, and London theaters, which were generally pronounced magnificent, seemed tawdry and rude compared with

that soft and exquisite brilliance which so transcends the power of the outer world to equal, or of the external senses to perceive, while in many works of art or design I could observe features in which I think the artist could have improved upon his work if he had seen these higher manifestations of nature.

IV. Many Persons can see these Higher Colors.

1. Thousands of persons are able to see these finer grades of colors, and some much more easily and clearly than myself. Some can see them with the eyes wide open in broad daylight, and that while in the midst of company or surrounded by the turmoil of daily cares. A Mrs. Minnie Merton, of New York, informs me that she has always seen them from her childhood, emanating from all human beings, and is in the habit of reading the character of people especially from the emanations of the head. For some time in her childhood she supposed that everybody could see them. An eminent legal friend informed me some time since that he had seen these colors in all their splendor for many years, but at first he found it necessary not only to close his eyes, but to put a bandage over them before he could witness them. A lady in Chicago, whom I had never seen before, saw in a moment, as she met me, while I was still 15 feet from her, what my profession was or ought to be from the radiations of my person. A well-known judge informed me that he could often tell the general character of a speaker's thoughts before they were uttered, from the colors of the emanations. An eminent physician stated to me that he could see countless flashes, radiations and explosive forces all around the head, and that the ganglionic centers often emitted an explosive light, especially under excitement. I have seen a large number of persons who could see beautiful colors around persons or other objects, but could not tell what it meant. In giving an account of these, I do not include all persons who can see colors on merely shutting up the eyes, for in some cases this comes from a somewhat de ranged nervous and bilious action, and in some cases, as in shutting up the eyes and turning them towards the light, the red blood of the eyelid gives a crimson hue as in ordinary light. Sometimes, when the intensity of this red is greater than that

which is ordinarily visible, it doubtless partakes more or less of the nature of odic light also.

2. *Reichenbach's sensitives*, as we have seen, *often saw the beginning of the psychic scale of colors, and probably at times they saw the full scale.* They often spoke of the beauty of the flames which they saw. Such expressions as the following are used: —"The columns of flame from each pole astonished her by their size and beauty;" "She described the appearance as one of extraordinary delicacy and splendor;" "Of uncommon beauty," etc. We have seen that in several cases they saw two grades of red as signified on pp. 393, 431, 436, etc., of Gregory's Translation. They saw shining emanations from the head and all other parts of the system, some of which must have been odic and others psychic.

V. These Colors Reveal the Higher Laws of Force.

1. The very fact that all objects radiate their own peculiar streams of light and color, while their interior potencies are revealed thereby, has given me the basic principles of the whole etherio-atomic law by means of which so many mysteries of force stand revealed. If, at first sight, the reader has deemed my positions at times as based on assertion with reference to the working of these different grades of ethers, without sufficient data of fact, it is proper that he should understand what a vast volume of facts could be given to sustain my positions, not only from my own experience, but from that of very many others. Besides this would it not be well for the reader to ask himself how I could have had the skill to hit upon those basic principles of force which so easily and naturally explain Attraction, Repulsion, Cohesion, Adhesion, Electricity in its various grades, Heat of various kinds, with the very law of movement required for its production, Light of different grades with the law of electrical and thermal colors, Chromo-Chemistry, Chromo Therapeutics, and many other points, if I had not been taught by seeing and feeling these wonderful fluidic emanations and radiations which are the law of all things? For this reason it strikes me as being exceedingly important to have these finer forces explained with some fulness not only as giving the fundamental principles of

the philosophy of this work, but of all philosophy of force both in external nature and in mental action, for, as we have seen, both the physical and spiritual universe are constructed on principles of absolute unity.

2. Many of our scientists, with a singular perversity of mind, grasp with all their souls after the grosser elements of nature, writing long treatises on a bug, a worm, a mineral, or a skeleton, but when marvelous facts are revealed with regard to these more beautiful essences of being, these lightnings of power without which the whole universe would be but a formless and lifeless mass of debris, they utterly fail to receive the glad tidings with philosophical candor, commence persecuting the discoverer as though he was an enemy, and return to the corpses and bones of the dissecting-room in preference to the radiant forms of the world of life. "We build on exact science and deal with tangible realities," is their watchword, and so they go right off in a carriage with one wheel into the pathways which lead to all confusion and inexactness of knowledge. Take, for instance, the common conception of a single ether which they conjecture must exist throughout all space. They have no facts to prove it, and have not the least idea of how the thousands of grades of force, luminous, thermal, electrical, magnetic, and molar are transmitted over and through it, but have endowed it with properties, as we have seen, at discord with all known law (Chap. Eighth, V). These exact men are immensely inexact. They cannot tell the cause of even so simple a thing as *muscular contraction;* are quite ignorant of *nervous force,* nervous diseases being confessedly the "scandala medicorum"; have but a dim conception of the cause of *sensation,* the laws of *mental action,* of *chemical affinity,* of the *fundamental potencies of drugs,* and many other important matters which after all these ages might have been understood far better if they had but condescended to inquire into the basic principles of power as they exist in the fine forces. "The brain of man itself," says Tyndall, "is an assemblage of molecules arranged according to physical laws; but if you ask me to deduce from this assemblage the least of the phenomena of sensation or thought, I lay my forehead in the dust and acknowledge human helplessness." (Amer. Lectures on Light). Ever grateful as an American for the simple and beautiful lec-

tures on light, and the donations in favor of scientific culture which this apostle of science has favored us with, still I feel confident that if he had not pushed far from him the investigation of these psychological forces, he could at least have understood *something* of the processes of "sensation and thought." I believe, however, that he would be too truthful to do as did the Vienna clique of Doctors with regard to Reichenbach's investigations, or as some British and American Doctors have done since that time. Referring to the Vienna Doctors, William Gregory, M. D., F. R. S. E., remarks as follows: "It is painful to think that parallel cases have not been wanting in England. The spontaneous somnambulism, and apparent transference of the senses, in Miss M'Avoy, met with precisely similar treatment; as did the very interesting facts which occurred in the case of Dr. Elliotson's patients, the Okeys. There was the same predetermination to find the patient an impostor, the same utter absence of all cogency in the evidence adduced, and the same rash and unjustifiable, as well as unmanly accusation of imposture, brought against persons of whom no evil was known, apparently because the authorities chose to assume the facts to be impossible. The still more recent case of Miss Martineau's servant girl is another instance in point. Having seen that girl, and made observations on her, I can speak with confidence of her honesty and truthfulness." Alas! If scientists cannot rise above prejudice into the pure atmosphere of truth, whom shall we trust?

VI. This Light Renders Opaque Substances Transparent.

1. This transparency, however, appears only to those who who can get *en rapport* with the finer light, and such persons are sometimes called clairvoyant, or clear seeing. In Chapter Ninth, VII, we have seen that Odic light often made bodies transparent, or at least translucent to the sensitives, and we might naturally expect that the still finer psychic light would render bodies still more generally transparent.

2. *Dr. Wm. A. Hammond* and *Dr. Geo. M. Beard*, of New York, have declared positively that no person ever did or ever will see through what we call opaque substances, or read with

blindfolded eyes. To make this assertion in itself of much value, we must first suppose these gentlemen to be omniscient and capable of grasping all the possibilities of man and the universe in order to know whereof they speak; and secondly, we must stultify ourselves by ignoring ten thousand facts which show that there are powers of vision in man aside from the external eye. I say ten thousand facts, but I believe I could collect in six months or a year, a million well-established facts from the records of England, France, Germany, Italy, Russia, America, and other parts of the world, and thus show that if these gentlemen are honest they are quite innocent of real knowledge of the facts. Both of them are very free in denouncing as fools or tricksters those who believe anything in this matter, but I have generally found that those who know the least of this subject are generally the most positive in denouncing those who know the most. In saying this I do not call them dishonest, but they simply possess such a materialistic bias of mind that all phenomena connected with the finer forces seem absurd to them, as they insist upon having them strained through their own imperfect spectacles. According to Dr. Leeds, "facts are the arguments of God," but Dr. Beard condemns the production of facts and the use of *induction* in this matter, and commends the exploded system of mere *deduction*. According to this the more we know the worse we are off, and *much* "knowledge is a dangerous thing," while *theories* only are safe. "The only way," says Dr. Beard, "to settle this question is through deductive reasoning," and this is his deduction which is to settle the point:—"No human being ever has, or can have any faculty different in kind from that conferred on the human race in general." Does not Dr. Beard know that the human mind takes hold upon the infinite, and that most men's faculties lie dormant, being developed as yet but little above the animal nature, while the faculties which are the very latest of development are those that deal with the fine spiritual forces? In Edinburgh, statistics show that 17 per cent. of the people are color blind, and in Russia a still larger number. Suppose Drs. Hammond and Beard should be cast upon some distant island where the whole people, or nearly the whole, are so undeveloped in the perception of colors that one is about the same as another to them. They show the

people a red object, and tell them it is red, and holding up a leaf tell them it is green. "It is false!" the people cry; "one color is the same as another." "But we can see some colors which you cannot see," exclaim our visitors. "You are deluded! You are tricksters!" they cry, "for one man cannot see any more colors than another!" They are then receiving the very coin which they are in the habit of dealing out to others, and which they would be the first to complain of. To these gentlemen, and the many others who adopt their methods, I would say—*It behooves those who are blind to be modest and not to dictate to those of us who can see, but sit at our feet and learn.* On the other hand we will sit at their feet and learn of them concerning matters in which they may have a superior perception. Such must ever be the spirit of philosophers, to whom truth is supreme, while the use of severe epithets contrary to reason, must rebound boomerang-like upon the senders. I will now quote a very few facts from superior sources with reference to this higher vision, after which I will endeavor to state just how such vision is accomplished.

3. *From Boudois de la Motte, Fouquier, Guéneau de Mussy, Guersant, Itard, F. F. Leroux, Marc, Thillaye, and Husson, Committee of the French Royal Academy, in 1831* :—"We have seen two somnambulists distinguish, with their eyes shut, the objects placed before them; they have told without touching them the color and value of the cards; they have read words traced with the hand, or some lines of books opened by mere chance. This phenomenon took place even when the opening of the eyelids was accurately closed by means of the fingers. We met in two somnambulists the power of foreseeing acts of the organism more or less distant, more or less complicated."

4. *From Wm. B. Gregory, M. D., F. R. S. E., Prof. of Chemistry in the Edinburgh University* :—(Some of the following I condense.) "Clairvoyance frequently commences by the sleeper's seeing the operator's hand. The eyelids, if opened forcibly, will show the eye turned upward and back so that the pupil cannot be seen at all in many cases, and when it can it is fixed and motionless, showing that sight must be caused by some inner vision." "The clairvoyant seems to go to a place mentally, or rather to 'float on the air,' for a while, when all at once he will exclaim,

'now I am there,' and will thus describe distant cities which he has never seen. He often reverses the points of the compass, but will describe people, streets, houses, colors, etc., correctly." "Some clairvoyants will give the time of the day at the places which they visit, getting it by means of watches and clocks, thus marking the different time signified by different longitudes." "He will often describe the wonders of his own body. When altogether ignorant of anatomy, he sees in all their beauty and marvelous perfection the muscles, vessels, bones, nerves, glands, brain, lungs and other viscera, and describes the minutest ramifications of nerves and vessels with an accuracy surpassing that of the most skillful anatomist. He will trace any vessel or nerve in its most complex distribution; the whole to him is transparent, bathed in delicate light, and full of life and motion." "Major Buckley has developed the ability to read writing hidden away in nuts or boxes in 89 persons without inducing the magnetic sleep or affecting consciousness. Most of these belonged to the upper educated classes. The longest motto thus read contained 98 words. Many subjects will read motto after motto without one mistake. In this way the mottoes contained in 4860 nut shells have been read, some of them indeed by persons in the mesmeric sleep, but most of them by persons in the conscious state, many of whom have never been put to sleep. In boxes, upward of 36000 words have been read; in one paper 371 words. Including those who have read words contained in boxes, when in the sleep, 148 persons have thus read." "A lady, one of Major Buckley's waking clairvoyants, read 103 mottoes contained in nuts in one day, without a pass being made on that occasion. In this and in many other cases, the power of reading in nuts, boxes and envelopes remained, when once induced, for about a month and then disappeared. The same lady after three months could no longer read without passes." "In this state the subject often possesses new powers of perception, the nature of which is unknown, but by means of which he can see objects or persons near or distant without the use of the external organs of vision," etc. (*Letters on Animal Magnetism*).

5. *From Rev. E. B. Hall, Providence, to Mr. T. C. Hartshorn, Translator of Deleuze's Animal Magnetism,* in which he speaks of a blind lady: "She described distant objects, whose

position in some cases I had just changed, whose existence in other cases I did not then know or believe, so truly, so wonderfully, that I could only marvel. At other times she has done the same with regard to my own house, and houses in other towns and states. I am convinced that she sees by some other organ than the eye, or with such rays of light only as can penetrate all substances, if there are any such. I have seen a sealed letter, containing a passage enclosed in lead, which letter she held at the side of her head not more than a moment all in sight, then gave it back to the writer, and afterward wrote what she had read in it. The letter was opened in my presence and the two writings agreed in every word, there being two differences in spelling only." The contents of the letter were as follows :—"*In these latter days, as in former times, the blind receive their sight.*" (*Appendix to Deleuze.*)

6. *Dr. Alphonse Teste, of Paris,* gives an account of some sentences which were read by Madame Hortense after they were locked up and sealed in a close box. The first was a passage from Lamartine as follows :—"*Le réel est etroit ; le possible est immense.*" The madame read "*le possible est immense,*" but skipped the rest. M. Amedée Latour then wrote a passage, placed it in the box and placed his own seals upon it. It was returned to him with the seals untouched with the following sentence :—"*L'eau est composée d'hydrogène et d'oxygène.*" "Well, you are the devil," cried he, "or magnetism is a truth."

7. The following fact with reference to *Swedenborg* is sanctioned by the great German metaphysician Kant, who remarked that it sets "the assertion of the extraordinary gift of Swedenborg out of all possibility of doubt." While in Gottenburg, on a Saturday night, he saw that a great fire was taking place in his native city Stockholm, 300 miles distant. On Sunday Morning he made a statement of it to the Governor, while on Tuesday morning the arrival of the royal courier gave full comfirmation of it. Other cases of his power could be mentioned.

8. *Alexis,* so well known in Europe, and who so often astonished the savans by his feats of vision and mental perception, has his eyes covered with thick masses of cotton, and then plays various games with experts, in which he usually wins. He is able to read the cards of his opponent and thus has the advantage.

9. *Miss Fay*, in 1856, in the presence of the Hon. Joshua R. Giddings and Stephen Dudley, Esq., in New York, exclaimed as follows: "I behold a sea of light extending everywhere, a never fading light. It is not of the sun or moon, or stars; oh, that I had the power to describe it! I must call it a divine light. It will never grow dim. I see no limit, but only an immensity of light. The sun fades beside it. The source appears like light creating light."

10. *Mrs. Mettler*, of Hartford, examined clairvoyantly some 40,000 persons during the first fifteen years of her practice, among which were many amazing triumphs of this finer vision. Dr. T. Lea Smith, from Hamilton, Bermuda, gives an account of an interview with her, in which he says she accurately described his island home and pointed out a weed which grew in abundance there, and which she declared would cure the yellow fever. In a letter written at Hamilton, Oct. 29, 1856, Dr. Smith says:—"During the last three months the fever has been making sad havoc in Bermuda, and we know not where it will stop; it is very bad among the troops, but I am happy to say that out of 200 cases treated by Mrs. Mettler's prescription, only four have died!" At another time he says she read an inscription on a tombstone in the cemetery at Hamilton. She was thus able, by the aid of this more exquisite light, to look something like a thousand miles and discover the real properties of a plant which the physicians on the spot had failed to do, and which was supposed to be a worthless weed. In another case related by Dr. S. B. Brittan in "Man and his Relations," Mrs. Mettler examined a gun-shot wound of a Mr. Charles Barker in Jackson, Mich., with which he had been suffering for months, and discovered a *piece of copper* in the wound, which she said would prevent it from healing until it was removed. "But young Barker was sure that he had no copper in his pocket at the time of the accident; and inasmuch as the medical attendant had made no such discovery, it was presumed that the seeress was mistaken. But some time after, the foreign substance spoken of became visible, when Mr. Barker's mother with a pair of embroidery scissors, removed a *penny* from the wound! In such a case science is a stupid, sightless guide, and must stand out of the way. The doctors in Michigan could not see that penny

when it was within their reach and their eyes wide open; but this seeress discovered it at a distance of 1000 miles with her eyes closed!" (p. 400.)

11. *Dr. Wm. B. Carpenter*, of England, has lately written a work disparaging the claims of clairvoyance, mesmerism, etc., to which Prof. Alfred R. Wallace has given a triumphant answer in the Quarterly Journal of Science, London, producing multitudes of overwhelming facts to show the reality of clairvoyance. I quote simply the following: "I refer to the testimony of Robert Houdin, the greatest of modern conjurers, whose exploits are quoted by Dr. Carpenter when they serve his purpose (pp. 76, 111). He was an absolute master of card tricks and knew all their possibilities. He was asked by the Marquis de Mirville to visit Alexis, which he did twice. He took his own new cards, dealt them himself, but Alexis named them as they lay upon the table, and even named the trump before it was turned up. This was repeated several times and Houdin declared that neither chance nor skill could produce such wonderful results. He then took a book from his pocket and asked Alexis to read something eight pages beyond where it was opened, at a specified level. Alexis pricked the place with a pin, and read four words which were found at the place pricked nine pages on. He then told Houdin, numerous details as to his son, in some of which Houdin had tried to deceive him, but in vain; and when it was over, Houdin declared it 'stupefying,' and the next day signed a declaration that the report of what took place was correct, adding, 'the more I reflect upon them the more impossible do I find it to class them among the tricks that are the object of my art.' The two letters of Robert Houdin were published at the time (May, 1847), in '*Le Siecle*,' and have since appeared in many works."

12. The foregoing cases, though but a drop in the bucket of what might be presented with reference to this beautiful law of vision, are quite enough to demolish the rash remarks of Drs. Hammond and Beard. It is no wonder that Dr. Beard thought it best not to appeal to facts, in a matter loaded down with such an overwhelming array of them. My own powers enable me at times not only to see objects, but to look through them to objects beyond without the outward eye, while I have known a

great number of people who can do the same. A lady in Chicago with whose family I resided for some time, could become quiet at any time and in a minute or two look into any residence of the city, or even of distant states, and tell whether the owners were at home or absent. I knew of no failures, and a gentleman who had tested her for one or two years told me he had never found her mistaken.

13. *One of the eminent lady physicians of New York* received a salary of $3000 per annum from a Life Insurance Company, on account of possessing this finer insight which so transcends all ordinary perception, and saved her company tens of thousands of dollars. I will simply mention one instance in proof. A gentleman of remarkably vigorous appearance had passed the examination of the physicians of the company, and was pronounced as "sound as a bullet." He wished to be insured for $10,000. Before accepting of his case, however, they handed a little strip of paper with some of his writing on it to the lady. Almost immediately, coming into rapport with the subject by means of the emanations from the paper, she declared that he would be a dead man within eight weeks, and warned them against taking him. They asked him to defer the matter eight weeks, which he agreed to. After seven weeks and two days the President of the company came with much excitement to the residence of the lady, and informed her that the gentleman had fallen dead with heart disease, on his own door step, that morning! In another case, a southern gentleman applied for an insurance policy of $10,000. This lady, on examining his autograph, saw a certain melancholy and diseased condition which she declared would lead him to commit suicide, and advised them against taking his case. They concluded to risk it however, and so lost their money, as he committed suicide the same year in Virginia.

VII. Explanation of this Higher Vision.

1. The *Philosophy of Ordinary Sleep* consists in the withdrawal of the ordinary vital fluids from the *cerebrum* or realm of mental action, to the cerebellum or center of the physical forces. These vital fluids, which are doubtless a modification of odic

force, animate the external or gray portion of the brain, draw the blood there, and thus bring about the ordinary grade of mental activity. It is well understood by physiologists that a free action of pure uncongested blood though the front brain is necessary to consciousness and thought, but how the blood itself is enabled to move thus freely or what is its vitalizing principle, except that it must be properly oxydized, have sufficient phosphorus, etc., they cannot tell. The clear seer, however, can actually witness the fiery streams of this invisible light, as they kindle the blood and brain tissue, and can see that when all the chemical conditions of the blood are proper, such as having a sufficient supply of oxygen, cholesterin, etc., these animating streams of nervaura, sometimes called animal magnetism, are all the more brisk, and mental action all the more clear. Wm. B. Carpenter, M. D., F. R. S., says that "although the brain has not ordinarily more than about $\frac{1}{40}$ of the weight of the body, it yet is estimated to receive from $\frac{1}{6}$ to $\frac{1}{5}$ of the whole circulating blood." (*Principles of Mental Physiology.*) He also says that of the four arterial trunks which convey blood into the skull, three may be tied and consciousness still remain, but if the fourth is tied unconsciousness takes place. One may become asphyxiated with depraved blood which has too much carbon in proportion to its oxygen, as chemical action of vital forces thus become too dormant, and congestion takes place. Persons of resolute will can often fire up this odic force by the finer psychic principle, and through that so animate the blood as to prevent many disasters even when the blood has become more or less impure. If a part of the animating ether is drawn off to the back brain and to the body, it carries a portion of the blood with it, and the front brain becoming thus inactive, a quiet condition takes place and a person begins to feel sleepy. If a greater quantity is drawn downward a dreamy kind of a sleep ensues, while a still greater quantity will leave too little action of the cerebral forces to be remembered at all, and so we call it perfect unconscious sleep. Dr. Durham demonstrated, in 1860, that there was far less blood in the cerebrum during sleeping than during waking hours. Where he had cut away the skull in animals, the vessels of the *pia mater*, which were full and red during wakefulness, became contracted and pale during sleep. The contrast was remarkable.

It must not be supposed, however, that the blood itself is the direct cause of mental action, but its free action through the brain awakens chemical affinity and constitutes a good conducting medium for the finer forces. During this quiet of the cerebrum, the rest of the system is doubly active, building up its cells and tissues to make up for the combustions and waste which take place during the waking hours. Ordinary Sleep, then, may be induced by whatever will draw this vital aura, and with it the blood, away from the front and upper brain, such as making passes downward from the head, laying the hand upon the back-head and back neck, warming the spine or feet, etc. *But how is it, if ordinary sleep thus stupifies, shuts up the faculties of the mind and renders it almost a blank, that the so-called mesmeric or lucid magnetic sleep opens up such new and wonderful powers of intellection which enables the sleeper to grasp the conditions of past, present and future with double power, and gives him a vision which seemingly penetrates through all substances and reveals the very soul of things?* I have not seen this point clearly answered, although the subject of psychology must ever have a misty aspect until it is answered.

2. *Somniscience, or the Lucid Magnetic Sleep, sometimes called Artificial Somnambulism, consists, not only in drawing away the blood and the vital ethers which usually kindle the phrenal organs into activity, but in calling into action the more interior, refined, swift and powerful psychic ethers that are more directly the handmaid of the spirit itself.* In other words, when we abstract the coarser forces we can the more easily get *en rapport* with the finer, just as the sensitives by taking the ordinary light from a room, could the more easily see the odic light. The outer and gray matter of the brain is the more immediate seat of ordinary sensation and mental action, while the more interior forces, quickened by the chemical affinities between the inner surface of the reddish gray matter and the outer surface of the interior bluish white matter, when called somewhat outward, produce a higher grade of mental action than the slower and coarser forces which are usually predominant, while if they are called still more outward and wrought up into still greater action, until the whole brain is suffused with this diviner light which blends with the same grade of light in the external world, this

higher vision takes place and a wonderful illumination of the mind is the result. I will illustrate by the process of outward vision. This is accomplished as follows:—The rays of light fall upon the retina of the eye where they stamp their image, which image is carried to the external sensorium by a grade of vital electricity that is just suited to it, and thus we get the effect of vision. *Bell's Telephone*, by which the human voice is transferred hundreds of miles, operates on much the same principle. The waves of sound strike an artificial diaphragm at one end of the line, and are transferred by means of electricity through a wire to another diaphragm and human ear at the other end. In human vision the first diaphragm is the retina at the back of the eye, the conducting wire is the optic nerve, the second diaphragm is the external sensorium in the outer gray matter of the brain aided by refining processes, and the ear of the listener represents the human spirit itself which takes cognizance of the whole. In certain magnetic conditions the eyes are wide open, but the ordinary light cannot make much impression as the internal corresponding vital electricity is withdrawn to other parts of the body. But the finer psychic ethers, having full play, receive the finer light that emanates from, or penetrates through all substances, and carrying it to the inner sensorium, which, according to the magnetic vision itself, seems to have its culminating point at the junction of the gray and white matter of the brain, the mind receives the exquisite images thus conveyed, and so the higher vision is perfected. By means of ordinary light we may see through all transparent bodies because the light itself can penetrate them, but by means of the psychic light, the vision may pass through nearly all bodies as easily as ordinary vision passes through glass, which accounts for what is called clairvoyance.

3. It is by no means necessary to get into this magnetic sleep in order to have this finer vision. Many can so cause the finer ethers of their brain to gain the ascendency over the coarser as to be able to see almost immediately, and that without even closing the eyes. Some learn to throw the animal forces away from the front brain by their will power, meantime assisting the action by throwing their eye-balls upward and back as in a sleeping condition. Those less developed in the matter

will frequently have to look at some object in front or above them, or thinking of some place intensely in order to draw the psychic forces sufficiently outward, and this in many cases a half-hour, an hour, or more at a time.

VIII. How to Develop this Finer Vision.

1. These finer ethers are so swift, penetrating and powerful that it is a very great achievement to be able to wield them for the sake of the wonderful powers of vision which they give, as well as for the great control of both bodily and mental forces which can be gained thereby. I will give some brief hints for the culture and control of these agencies.

2. When convenient it is quite desirable to have a person who is already well charged with these fine forces and who can himself see clairvoyantly, make passes over the head downward and especially over the eyes and forehead, and thus impart his own power to the subject. Sometimes these passes can be made from the head to the feet along the face and body, and sometimes one or two inches from the body.

3. Dr. Braid, of England, who styled this magnetic sleep *hypnotism*, was in the habit of having his subjects look steadily at an object placed in front and somewhat above them, for some time. Such a process will answer very well for awhile, after which downward passes will be useful.

4. One of the most practical methods of developing these forces is to sit somewhat reclining in an easy position with the back to the north or a little north-east, have merely a dim light rather than otherwise, close the eyes, turn the eye-balls a little upward, if they can be held so without pain, and then steadily and gently make an effort as if to see. This can be practiced for a half hour to an hour or so each time, and while doing so the thoughts should not be allowed to wander, but the aim should be to see if lights, colors, forms, and motions make their appearance. If colors do not appear in a few days, the prospect for clairvoyance is poor unless assistance can be imparted by persons already developed. Dr. Fahnestock, of Pennsylvania, has developed what he calls *statuvolence* or *artificial* somnambulism, which he says can be acquired by all in from one to twenty sittings, while most

of the persons who attain to it gain the *clear vision.* This will be described in X of this chapter.

IX. The Psychic Force a Great Power to bless Mankind.

1. *Because it brings into action this sublimer vision* which reveals the wonders of both the interior and exterior universe in a way that entirely transcends the power of the telescope in the distance of its scope, the microscope in the minuteness of its power, and throws both into shadow by its ability to reveal the realm of intellect and that finer radiance which can never be seen in the external world. When its powers have become more developed, mistakes of vision will be more rare, and discoveries of vast importance in psychological and physiological phenomena will be made.

2. *Because through the Mental Forces it is able to build up and heal the physical system* in a way sometimes which would seem almost too marvelous for belief. Dr. Gregory says "an immense number of magnetic cures have been recorded;" Dr. Elliotson commends it highly and enumerates cases of Epilepsy, Insanity, Hysteria, Paralysis, Chorea, Hypochondriasis, Sick Head-ache, Convulsions, Nervousness, etc., and a severe case of Cancer, as having been cured by the human magnetic (or psychic) forces. The Zouave Jacob of France who was wonderfully charged with these forces, cured multitudes by a mere touch of the hand, and many times without touching his subjects at all. This was done when they were in their normal condition, by a powerful effort of his will. Sometimes a score of policemen were required to regulate the crowds who pressed forward to be healed by him. Downward passes over the body soothe and quiet excited nerves, and upward passes arouse dormant and cold portions of the body.

3. *Because it has a remarkable and unequaled power in improving imperfect mental and moral conditions.* I have charged and regulated the psychic forces of different parts of the brain and their negative poles in the body in a way to quell the appetite for liquor in several persons, to abate their animal passions, and to stimulate to much greater activity the mental and moral forces. The achievements accomplished under the form of Psychic influence, called statuvolence, will be described shortly (X). I will

quote a passage from an eccentric writer, named P. B. Randolph, which will apply here :—"We have known a sweet Miss only six years old, to thoroughly mesmerize her great burly uncle, a man capable of knocking a bull down with one stroke of his ponderous fist, and who was one of the roughest sea tyrants that ever trod a quarter-deck, and yet the little lady rendered him not only helpless, but clairvoyant by repeatedly manipulating his head, while he held her in his lap in his daily calls. She had witnessed a few experiments, believed she could do the same, tried it four times and accomplished it in great glee on the fifth attempt. But the greatest miracle of all was, that the captain's nature became entirely changed, and to-day a better or a gentler man does not sail out of New York harbor!" (*New Mola.*) In the case of this captain, the finer forces of the man, combined with a gentle pure element from his little magnetiser, were doubtless made to permeate and refine the region of his external brain. "In the highest stages of the magnetic sleep," says Dr. Gregory, "the countenance becomes irradiated and heavenly beyond the power of art to picture, and the language becomes exalted." I have several cases in view in which persons have dated the commencement of a nobler and truer life from the development of these higher elements. That some fortune tellers may really have the ability at times to use them and convert them to a low end, does not argue against the holier purposes to which they ever may and should be consecrated.

4. Because it begets a keenness of vision and mental perception, which when it becomes widely developed will so penetrate through all fraud and hypocrisy as to greatly destroy their practice. A lady of New York traced out a thief and recovered diamonds of the value of $10,000 for one party, and has found a large number of stolen watches and other articles by this superior vision.

X. Statuvolence, or Self-Psychology.

1. Statuvolence is a phase of power brought about by these same psychic ethers, wielded and developed on a somewhat different plan from those which we have been considering. Dr. Wm. B. Fahnestock, of Lancaster, Penn., has devised the name

and method of operating, and has wrought some remarkable cures and effects even on the mental system by its means. It is, moreover, one of most effective methods of developing the higher vision, and of assisting a person to gain control both of his physical and mental forces. Dr. Fahnestock does not seem to understand the philosophy of this power any more than did Dr. Braid and most others who have writen upon this and similar subjects, but is deserving of credit for his successful experiments. He and Dr. Braid, and Dr. Brown-Séquard, and very many medical men, deny that there is any magnetic fluid because these singular phenomena seem to come from *belief* or *imagination*, or the *mind* in some of its manifestations. This is simply on a par with denying the existence of sunlight, because the sun itself shines. How do these gentlemen suppose the *mind* or *imagination* can do these things without some instrument to do them with? The sun starts vegetation into life because it sends its light to the earth. Mind or volition wields the human system because it sends out its psychic and animal ethers.

2. The process which Dr. Fahnestock uses to bring about the state is simply a method of drawing the interior forces outward. I quote his own words:—"When persons are desirous of entering this state, I place them upon a chair where they may be at perfect ease. I then request them to close their eyes at once and remain perfectly calm, at the same time that they let the body lie perfectly still and relaxed. They are next instructed to throw their minds to some familiar place, it matters not where, so that they have been there before, and seem desirous of going again, even in thought. When they have thrown the mind to the place, or upon the desired object, I endeavor by speaking to them frequently to keep their mind upon it. This must be persevered in for some time, and when they tire of one thing, or see nothing, they must be directed to others successively until clairvoyance is induced. When this has been effected, the rest of the senses fall in at once, or by slow degrees. If the attention of the subject is divided, the difficulty of entering the state perfectly is much increased, and the powers of each sense while in this state will be in proportion as that division has been much or little." Sometimes as the especial condition approaches, the subject will feel that he is falling away or floating off, but there is no occasion

for alarm. The thoughts being intensely concentrated on the place or object, he will begin to feel that he is there in person and can see what is going on, hear the words that may be spoken hundreds of miles distant and take cognizance of the very thoughts. When thoroughly in the state, the subject, at the request of the operator, can use these forces with a wonderful power, can will a certain disease to depart and it will very frequently leave, can determine to be strong, firm, self-controlled, after waking from the condition, and he will find himself in possession of a new strength; can will to have his head in the ordinary conscious condition, and have all sensation leave his hand, or foot, or any other member, and it will be so to such an extent, that he can look on and see it amputated without any pain, and can determine to have a certain condition of mind permanently, and it will be very likely to take place. By a little practice, after once getting into this condition, he can throw himself into it in a few moments and be master of himself. I know of a lady who, when she goes to have a tooth pulled, can put herself into the condition immediately and, willing all sensation from her jaw, will feel no pain when the operation is performed, which signifies that this mighty psychic force under the mind can hold the sensory nerves entirely in check. Some of these statuvolists become remarkably clairvoyant, profess to look in upon different parts of the world, or even other worlds, and describe their people, although their astronomical ideas are not always reliable, as they see people in worlds which evidently possess no people, which shows that they are looking at the wrong world, or else have their vision but partially developed. In many cases their clairvoyance is proved to be entirely correct. I had a lady patient who would describe what was going on at her home in another state, and she said she was not quite sure whether she really saw her people and certain neighbors, or whether it was imagination, as she was but partially in this condition, but on writing home she found she was exactly correct. One day she stated that a certain acquaintance of hers was treating her too familiarly, and he held her under a kind of a psychological spell so that she had no power to resist him, and grieved over it, confessing also that she had been in the same helpless state before in the presence of another gentleman. I

told her that that weak condition of the will power must be changed, and getting her into the statuvolic condition not fully, but so much so that she could see her home and friends, I then impressed upon her the baseness of an attempt to exercise an improper control over another, and the grandeur of having self-command, and asked her to will with all her power to be now and afterward strong and self-poised, which she did most earnestly. She found no trouble afterward in holding her annoyer and all other persons at a proper distance, and during the months after that in which I met her, I saw she had more independence and force of character than before.

3. *Case of Melancholy from unrequited Love.* I will quote a single case of mental control from Dr. Fahnestock's work on "Statuvolence or Artificial Somnambulism":—"Miss —— had been desponding for many years. She was induced to try somnambulism for her relief. She entered the state perfectly the first trial, in less than ten minutes; and after she had been in it for some time, I asked her, as is usual in such cases, whether she did not think it was better for her to forget an attachment that could not be returned?

"She said 'Yes I believe it would.'

"I asked her whether she was perfectly satisfied to do so and to become lively and happy hereafter?

"She said 'Yes; and I am resolved that it shall be so.'

"With this understanding I requested her to awake. She awoke and retired with a friend. I have since been informed that she has banished the circumstance from her mind entirely, and has become lively, contented and happy every since."

4. *A merchant of Boston* informed me that in the quiet of the morning, when his mind was in a calm state, he would generally will to be in a certain frame of mind all day, and in this way gained such a control over himself that nothing would disturb him. He also possessed a marvelous control over others without uttering a word, holding fifty men who were under his employment in absolute harmony with his wishes. He once caused a man to leave an audience and follow him through the streets, and into his own home, by mere volition without a spoken word. This and a host of other examples which could be given explode the idea that this power is imaginary, and shows that

human beings can throw out their magnetic curves to *hook around* and influence others, just as a magnet can attract iron, only with a finer power. In his younger mischievous days, he broke down a clergyman in the midst of his sermon by looking steadily and strongly at him, which fact is explained by clairvoyants who can see streams of fiery light issuing from the eyes. It is well known that Daniel Webster's gaze once completely confounded a young clergyman in the same way, so that an older clergyman present had to rise and finish the sermon for him. On being asked afterwards what was the difficulty, he said "he couldn't endure those great terrible eyes." But this was not to be wondered at, for the lightning from those eyes combined with that which went forth with his voice and accompanied with great ideas, had enchained many a listening senate before that day. As orators become more refined by living noble lives, and learn more about the control of these divine forces, they will have the greater skill in swaying an audience and inspiring them with great purposes.

5. *Dr. Fahnestock mentions the cure of six cases of Epilepsy, besides other cures of Rheumatism, Erysipelas, Scarletina, Chorea, Amaurosis, Hysteria, Fevers, Labor-pains*, etc., and shows its remarkable use in obstetrical cases. In my own practice I have found it also a great assistance.

6. *In Psychology and ordinary Mesmerism*, the operator generally comes near to or even touches the subject and makes his own forces predominate in the subject's brain. In this better method of Self-Psychology, the subject develops his own powers and becomes strong of himself as the operator sits outside of the coarser magnetic sphere, part way across the room from the subject.

7. Mr. Thomas C. Hartshorn, translator of Deleuze, gives a number of accounts of persons who were placed in the ordinary magnetic sleep and then required to decide against the use of tea, coffee, snuff and various articles of food which were hurtful to them, with the proviso that if they were taken any more they should create nausea. When they awoke they knew nothing of what had been determined upon, but could not take the articles without their becoming sick, or did not wish them and so they lost all desire for them. Dr. Cleveland of Pawtucket caused several

somnambulists to become far more cheerful, hopeful, and orderly, which remained as a permanent quality afterward. In one he induced a charitable spirit towards one who was intensely hated. What a heavenly transition it would be if a few million people could be magnetized and then made to abandon selfishness, hatred, gossiping, jealousy, overreaching their neighbours, etc. An intelligent New York merchant, who is highly charged with these psychic forces, informs me that many persons addicted to intoxicating beverages have lost all desire for them after being with him a few times. While with them he would feel an aversion for these intemperate practices, and his own strong forces must have penetrated theirs sufficiently to constitute a controlling power there. A person who thus aspires after the high and good can radiate silently and unseen an influence which shall bless and beautify the natures with whom he associates, while another, who yields to low and impure desires, sends out a subtle virus which tends to contaminate those who are not firmly grounded in principle.

8. The *Hundreds of Lives Lost* in the burning of the Brooklyn Theater, and the multitudes more which have been destroyed in church panics and elsewhere, could in many instances have been saved if the people had ever gained any proper psychological control over themselves. Fear being appealed to starts the animal forces into a mad rush through the brain, and these not being held in check by the psychic control which should ever be masters of the castle, confuse the intellect and destroy the common sense until the people rush over and crush each other and block the way, thus leading to their death. Dr. Williams, the Psychologist, told the members of an audience in St. Louis that he would give any man $10,000 if he would remain quiet every morning for a year and use his will-power 20 minutes before rising, if at the end he did not admit that he had received vast advantages therefrom. A gentleman did so and gained such additional power of mind and body that he said he would not take $10,000 for it. This will-power should be used in throwing the animating forces to all parts of the system, and in determining to be calm, just, gentle, and yet self-possessed through the day, whatever excitement may occur around him.

XI. The Colors and Forces of the Brain.

1. The *Encephalon* embraces such an almost infinite diversity of colors, centers of Luminosity, of volition, emotion, sensation, consciousness, intuition, nervous action, of animal, mental and spiritual power, and the positive poles of all human forces, that if an ordinary mind could possibly look in upon it and see all its amazing machinery, he would find it more complicated and containing a greater number of distinct objects than his present conception of a world. And yet, although man in his infinite unfoldings, capacities and parts is thus a study for an eternity, still by the aid of philosophy and this wonderful grade of light, we may at least arrive at the great general principles of vital and mental action, and grasp many details of these diviner laws of power.

2. *Different Forces of the Brain.* Dr. J. R. Buchanan, Professor in the New York Eclectic Medical College, is perhaps the most eminent of Neurologists and Cerebral Physiologists, and one method by which he has gained his superior knowledge has been by consulting this finer vision and also by charging with the finer ethers which flow from the end of the fingers, different portions of the brains of sensitive persons, each portion of which caused its own peculiar manifestations. In 1842, he made a number of experiments in the presence of the poet William Cullen Bryant, Dr. Forry and Mr. O'Sullivan. When he touched the organ of self-esteem in a lady, it became active under the vital fluid thus communicated, she kindled into importance and began to proclaim woman's rights; when he touched what he calls the organ of Humility, she at once changed her tone and said that "she was but a weak woman after all." When he touched another lady's self-esteem she left the room from feeling herself too good to remain with such company, but was induced to return when Humility was touched. When he touched a section of the brain which he terms Infidelity, she would believe in nothing and denied all things. They asked her if she did not think that the stove was hot. She immediately declared that it was not hot at all, and would have put her hands on it to prove it, had her husband not prevented her. Thus he could seemingly play any tune he pleased on the human instrument. A sensitive young man touched the poet Bryant on his Ideality, and thereby

his own ideality became so charged with new fire that he soared off into the most glowing language, and many other effects were produced. Similar experiments were tried by Dr. Elliotson of England, and by O. S. Fowler and others in this country. Dr. H. H. Sherwood gives an account of a lady whose "sense of hunger, produced by exciting the organ of Alimentiveness, was so great as to require a considerable force to prevent her from eating the flesh from her own hands; and the sense of the ludicrous, produced by exciting the organ of Mirthfulness, was such as to make it necessary to remove the excitement immediately to prevent her from laughing herself to death." These facts show 1st, that different parts of the brain have their special mental and emotional characteristics; 2dly, that these get their activity from the vital or psychic aura which passes through them; 3dly, as much of the character and conduct of human beings come from adventitious circumstances and conditions of the brain which, in their present ignorance, they do not know how to remove, they should not be held up to scorn and considered as so severely accountable therefor, but those who are physicians should see to it that by becoming acquainted with the working of the psychic lights and forces, and the phrenic organs through which they move, they should be able to correct and control these perverted conditions by reaching their causes; 4thly, the vast diversity of effects produced on different portions of the cranium should lead physiologists to abandon at once the absurd position that "there are no special organs of the brain for special qualities of the mind." I shall presently add another proof of the diversity of the functions of the brain by showing the different colors which emanate from them, and which exactly harmonize with the nature of the organs themselves, as ascertained by phrenologists.

3. I will quote some *cases from real life* as illustrative of the importance of these great fundamental principles. A lady of New York became more and more melancholy in spite of religious consolation or kind friends, and, baffling the power of her physicians, she was fast becoming insane. Going to a lady physician who possessed this psychic vision, it was discovered that the region of cautiousness was over-active, while that of hope had too little radiation of the psychic ethers, showing that

it was too dormant. She at once drew off by passes the superabundant forces of cautiousness, and charged with her fingers the organ of hope, and paid some attention also to the portions of the body which correspond to the same. I saw the patient after a week's treatment. She had become exceedingly cheerful, and was attending to her daily duties, seemingly a well woman. I have myself worked on the same plan in a number of cases and with admirable results. I have taken persons whose strong animal passions were leading them into excesses, and worked great and radical changes in their disposition and feelings. Such are generally heated and sometimes diseased in the lower back brain at and below the region which phrenologists generally designate as amativeness, and those who can see the color emanations from the head, discover a muddy red light issuing from the same portion in such cases. My process has been to draw the hot forces of the back brain by passes of the hand over the part and down the arms to the hand, also to draw the heat of the negative pole of the same organ which Dr. Buchanan has located in the lower spine, between the lumbar and sacral plexuses, down the hips towards the feet, and to equalize the system generally. The passion for alcoholic stimulus I have frequently quelled as follows ; 1st by drawing the heat away from the portion directly in front of each ear ; and 2d, by scattering in different directions the heat of the epigastrium, and sometimes cooling it off by fingers wet in cold water, especially as an inflamed gastric membrane is a great cause of the burning thirst for liquors. The fact that I am strongly charged with the vital magnetic power was no doubt a help in the matter, as I was able to infuse through the patient a healthier flow of the life currents, but nearly every one could do something in mitigating such evils by knowing how. A person of stupid perceptions can become quickened by animating the region over the eyebrows, by passes with the hand, each day; his reasoning powers can become quickened by holding the hands over the forehead ; his moral powers by charging the whole upper head. At the same time the whole system should be exercised and kept in as healthy a condition as possible, as the bodily organs react upon the brain. One thing should be remembered, which is, that a person of fine reasoning powers and high-toned moral nature is especially desirable as an operator to

stimulate the nobler intellectual and moral forces in another. For want of space here I must leave this subject only partialy explained, meantime reserving it for a much fuller explanation in a future work on *Human Development*, which I hope to prepare. Reformers and religionists have been trying for centuries to bless and save the human race, but the wrecks of humanity which cover the world, and the vice and corruption which fill society on every hand, proclaim that our methods have been false, that we are simply dealing with the surface of things and neglecting those interior basic principles upon which the structure of human life must be built if its foundations are to be eternal. The people in general are not only grossly ignorant of the proper prenatal conditions requisite for producing a magnificent manhood and womanhood, but more than this, having started a race full of imperfections, they are quite ignorant of the methods of making them over into something higher. The Medical world, the Pulpit and the Academy of learning are grossly culpable if they fail to impress these momentous laws upon the people, and a future bar of public opinion will hold them severely responsible. They may do something in laboriously bailing out a vessel which is full of leaks, but they would act much more like philosophers if they would deal with causes and stop the leaks themselves.

4. *The inspired Plato* well understood the basis of mental action which many physicians of the present day seem to be unacquainted with. "It is not art," said he, "which makes thee excel, but a *divine power* which moves thee, such as is in the stone which Euripides named the *magnet*, and some call the Heraclian stone which attracts the iron rings."

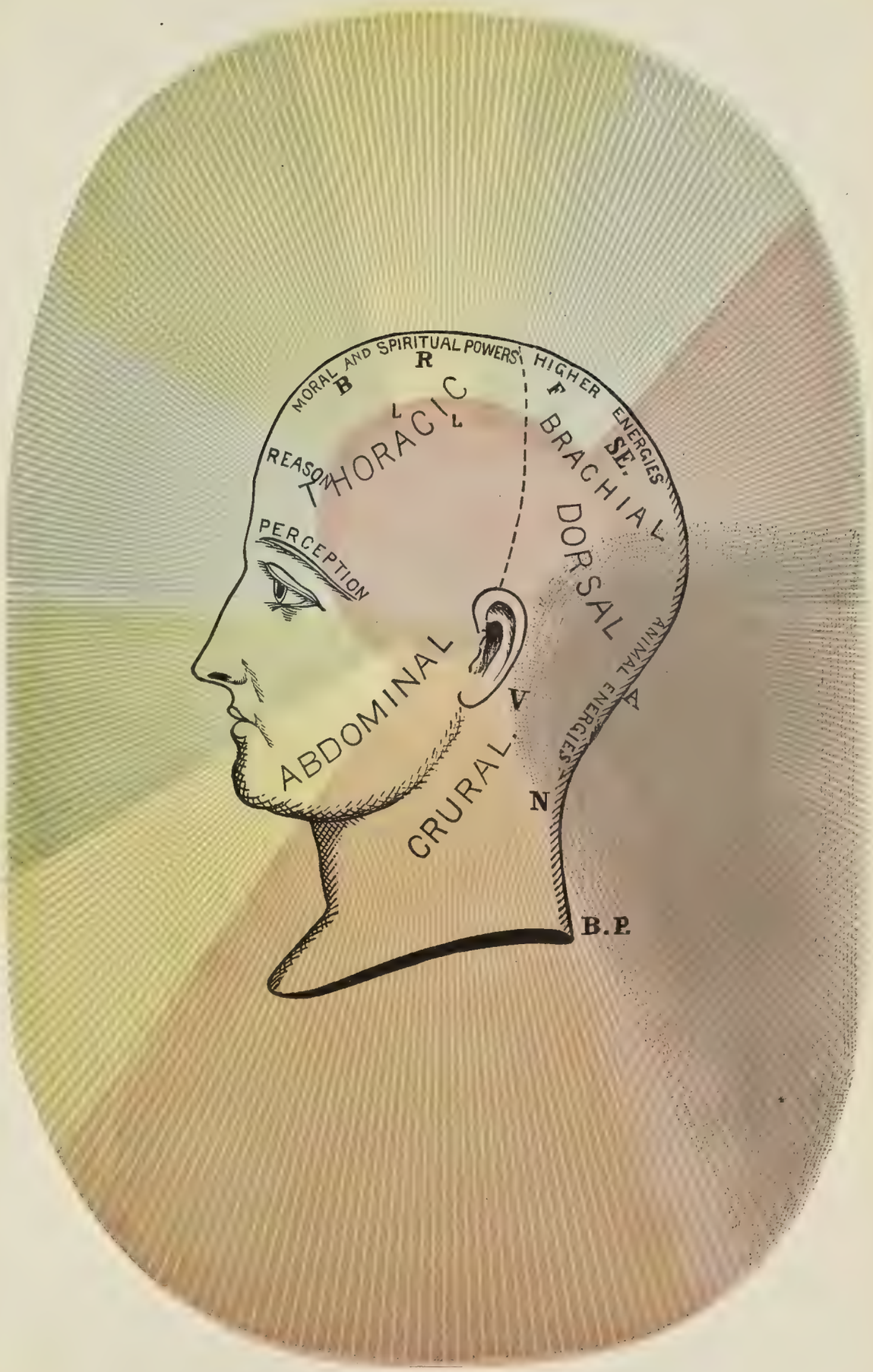
5. *Dr. J. R. Buchanan* has arrived at an excellent perception of these finer life-ethers, and admits the gradation of forces as follows :—"The action of the brain and nerves upon the muscular system is affected by an agency strikingly similar to the galvanic. This agency or fluid which is evolved by the basilar portion of the brain, the spinal cord and the ganglionic system, is one of the lower species of nervous fluids. The nervous fluid or emanation, which may be most appropriately termed NERVAURA, is essentially different in the different organs. While the nervaura, or influence of the basilar portion of the brain, directly and powerfully stimulates the muscular system, that of the

anterior region is incapable of producing muscular contraction, and tends to soothe or arrest. The nervaura of the basilar part of the middle lobe, in front of the ear, excites the digestive organs, that of the superior organs adjacent to firmness, diminishes the gastric activity. Thus, every portion of the brain originates a distinct nervaura, producing different and peculiar physiological effects, and producing also peculiar psychological effects upon others. The influence of the basilar and occipital organs is chiefly expended upon the constitution of the individual; that of the anterior and superior organs is more diffusive. * * * In the vast interval between our spiritual nature and the solid forms of inorganic matter, we have traced a regular gradation from solids to liquids, from liquids to gases, from gases to imponderable substances and agencies, from the imponderables to the various species of nervaura, coming from the basis of the brain to the higher forms of mental emanation, proceeding from the anterior superior portion of the brain. * * * Matter in a fluid form manifests more extraordinary, active powers (than solids), and presents phenomena which are the subjects of chemical science. It is only in consequence of the existence of fluids that vegetable and animal life are possible. * * * In Caloric, Electricity, Galvanism, Magnetism, etc., we find the moving powers of the physical world. Partly in these, but chiefly in still subtler agencies—in the vital forces and nervauras—we find the moving powers of the physiological world. The subtlest of these agencies again conduct us into the Psychological world. In other words all physical phenomena, all life and all thought—in a word, all POWER comes from immaterial sources." (*Anthropology*, 1854, p. 194.) These are noble thoughts, but the expression "all power comes from immaterial sources," would be better I think, thus—"*All power in its positive or primary principles comes from spiritual sources*," for as we have seen, spirit and matter are correlative, and neither can ever work without some grade of the other. The word *immaterial* is now being dropped by thoughtful writers, and I presume Dr. Buchanan himself does not use it at present.

6. *The Color Radiations of the Brain.* "Human beings are luminous almost all over the surface of their bodies," says Reichenbach, "but especially on the hands, the palms of the hands,

the points of the fingers, the eyes, different parts of the head, the pit of the stomach, the toes, etc. Flame-like streams of light of relatively greater intensity flow from the points of all the fingers, in a straight direction from where they are stretched out." Reichenbach's sensitives were not sufficiently developed to see the higher color radiations of the brain with much distinctness, although they saw some of them. The following description of the Psychic colors was written out by Mrs. Minnie Merton for the author's "Health Guide," from which work I extract it:

"In the base of the brain (the animal loves), the colors are a dark red, and in persons of a very low nature, almost black, while in the upper brain the colors assume a yellowish tint, and are far more brilliant. In a high nature, the colors over the moral and spiritual powers are almost dazzling, with the yellow tint nearly merged into white, and far more exquisite than sunlight. In the higher front brain, in the region of the reasoning intellect, blue is the predominant color, and is lighter as it approaches the top brain, and a darker blue as it comes down to the perceptives (over the brow), and a little touch of the violet in its outer edges. Benevolence emits a soft light green of indescribable beauty. Over firmness the color is scarlet, and over self-esteem, purple. As you move down the sides of the head, from the moral powers towards the lower loves, it becomes orange, then red, then dark (at the bottom). Very low natures sometimes emit such a dark cloud from the base of the brain, that it seems as though I could scarcely see them. When a person laughs or sends forth happy thoughts, it causes a dancing play of bright colors; but when in violent passion, a snapping and sparkling red is emitted," (p. 55). An eminent clairvoyant informs me that this description is mainly in harmony with the colors as he has seen them, and it also coincides nearly with my perception of the same. In saying firmness was of a scarlet color, I think it is an oversight, as I heard her in private conversation admit that there was a blue on the upper head behind the yellow which would bring it about over firmness, in accord with my own perception. Firmness seems to form the upper end of a mass of polarized lines of force which run down through the whole spine, and thus, when active, causes the whole being to become braced up into a rigid and powerful condition, hence the effect which



PSYCHIC LIGHTS AND COLORS.

On the lower face of the above the artist has placed the green and yellow too low. The yellow should come over the mouth, then a slight orange merging into a red at the chin, which continues all the way to the occiput, at which last point it assumes a more muddy cast.

we call *firmness*. But these firm conditions, or polarizations, come from electricity, and electricity is the blue principle, so that both theory and observation agree in the matter. I have drawn the colors and had them engraved in Plate IV., according to Mrs. Merton's description, modified and completed by my own observations, assisted somewhat by others. The combination, as in nature, is so soft and indescribably exquisite, and the variety of tint is so vast that it is impossible to give anything more than the general plan of colors, and that with materials many times as coarse as the radiations themselves. The eyes, perceptives, and reasoning powers radiate blue emanations, the animal energies, including Amativeness or sexual love (A), a dingy red, what Dr Buchanan calls the higher or more celestial grade of Love, LL, is a most beautiful grade of red; Benevolence (B) is an exquisite green; Religion (R), is yellow; Firmness (F), is blue; Self Esteem (SE), is purple, etc. Dr. Buchanan places Hope just above LL, and Patience and Integrity in front of Firmness. The blue of the Reasoning powers is a grade higher than that of firmness, the red of the front lower face is finer and more brilliant than that of the back head, and the red of LL is possibly a grade higher than the psychic, as is the yellow of Religion or Veneration, as it is sometimes called. These would then belong to the fourth grade of colors, and the same celestial grade may, in the greatest exaltation of mind, be used in the reasoning powers also. The nose has a green emanation, the lips yellow, below the lips orange, the chin scarlet, the temporal region below LL violet, merging into the finer red above and the coarser red below. This violet section includes Ideality, Sublimity, etc., according to Dr. Buchanan, but is slightly lower than these organs, as placed by the Gallian Phrenology. I have laid off the head in general divisions mainly after the plan of Dr. Buchanan. The anterior upper brain connects with the Thorax, or rather has its negative poles in the Thorax; the Higher Energies connect with the Brachial Plexus of nerves (B P); the occiput generally connects with the Dorsal nerves, the lower occiput with the Lumbar and Sacral plexuses at the lower spine, the lower cheeks with the abdomen, etc. The part of the head in front of the dotted lines rules the Visceral system, that back of them rules the muscular system. It will

be seen that the opposite parts of the head seem to be polarized or arranged quite generally with affinitive colors, the red of amativeness balancing the blue of the Reasoning organs, etc. The front brain has a higher grade of colors than the back, and the upper front brain still higher, as the most exquisite ethers, being the lightest, must naturally gravitate to the highest point. Dr. Buchanan ascertained by experiment that the highest part of all organs is nobler than the lower, the upper part of Self-Esteem, for instance, causing a person to have pride of moral character, and the lower part pride of power ; the upper part of Ambition (approbation), tending to moral achievements, the lower part to military achievements, etc. The colors as witnessed by a clairvoyant harmonize beautifully with this idea, growing more pure and brilliant as they approach the upper brain, and being far more magnificent in a high and noble nature than in a low and selfish one. *This shows that refinement of mental or spiritual qualities manifests itself by refinement of physical emanations.* The region of Religious aspiration (R), pointing heavenward, is the sunrealm of the human soul, and the most luminous of all, being in a person of noble and spiritual nature of an exquisite golden yellow, approaching a pure and dazzling white. The front brain being the realm of Reason and Perception, manifests itself naturally in the cool and calm color, blue, while the love principle, typified all over the world by warmth, finds its natural manifestation in the red. Such faculties as those of Ideality, Spirituality, and Sublimity, combining as they do both thought and emotion, radiate the violet, or the union of blue and red, while such faculties as Patience, Firmness, Integrity, and Temperance, have more to do with coolness than heat, and have a predominance of the blue. According to Buchanan's arrangement they are all situated in a group. The letter V is a vitalizing center, and N a center of nutrient nerves, as designated by Buchanan. The nerves of both centers may be roused to greater action by holding the hands on the place, or by rubbing with the ends of the fingers.

7. There is a great resemblance between the colors of the human head as to their direction, and the colors which flow from a bar magnet when turned over vertically, as seen by Reichenbach's sensitives, thus showing the harmony between man and the outward universe.

I give this after Reichenbach, and it will be seen that the face corresponds most nearly with the north, the occiput with the south, the top of the head with the zenith, and the lower head and face with the downward direction. A little below the north is the violet which is not imitated in the face except at the sides, while the blue of the upper occiput is omitted in the magnet, but the head of course is more complicated than the simple forces of nature and is modified more or less by the body of which it is the capital. In the foregoing figure the brilliant yellow above melts into the green, then into blue, then into dark blue, which is exactly imitated in the head and face, commencing with the yellow of the top head, and ending with deep blue at the eyes which correspond with the north. Below and above at the south and the north, and at several intermediate points the resemblance is almost exact. Thus we have the finer and the coarser forces, spiritual emanations and physical emanations, and the laws of nature and man all working together on the same wonderful system.



Fig. 185. Odic Colors from the North Pole of a Magnet made to revolve vertically in the Magnetic Meridian.

8. There are two great leading styles of radiation from the human system, one of which consists of straight lines that emanate in all directions and are not sufficiently deflected by counter currents to form into curves, while the other consists of systems of lines which have been deflected and formed into magnetic curves that pass round and round in and out of the brain in endless circuits. Fig. 186 gives a few from among the millions of straight line radiations, while fig. 187 presents a few of the magnetic curves which also circulate in almost infinite numbers in a vast variety of directions, only a few of which I give in the engraving. There is a system of efflux curves or

positive radiations from the right side of the head and face which sweep around and become influx curves on the left side, and there are circuits behind, which enter on the right side of the cerebellum and emerge on the left, just contrary to the directions of the frontal forces; and there are systems of straight



Fig. 186. The Angel of Innocence.

line forces which enter at the left and emerge at the right more strongly than they do in the opposite directions, and other systems which glide conversely through the whole body from head to feet, and feet to head, and far beyond into space, and still other systems which are influx behind and influx from the fore-

head and face, and in fact too many other divisions to mention here, although I have named some of the more important. When I speak of the forehead and right side as strong in positive and efflux forces, I mean in electrical forces, although the thermal radiations are just in the opposite directions as signified by the colors and other phenomena. I make these statements from the observations of Henry Hall Sherwood, M. D., of Baron

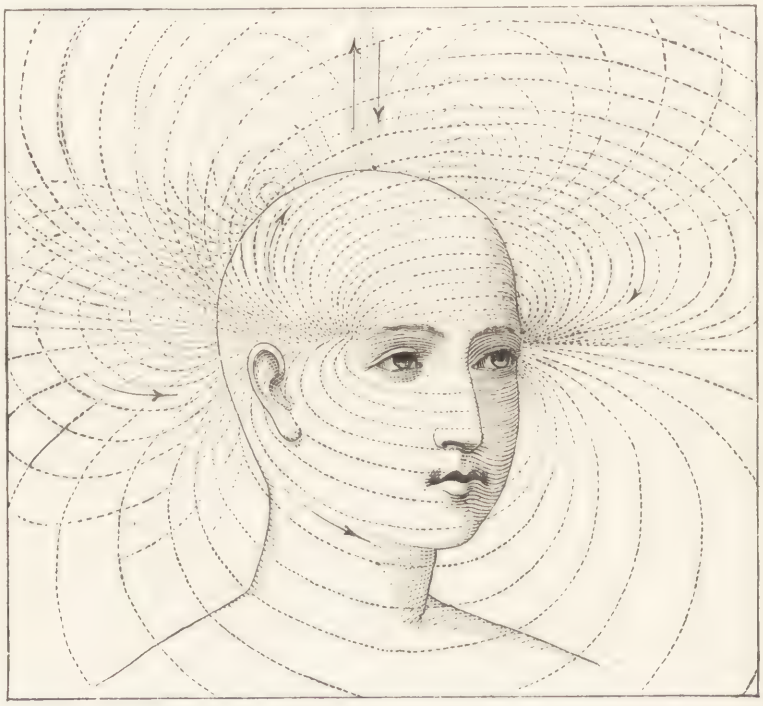


Fig. 187. The Psycho-Magnetic Curves.

Reichenbach and other persons, as well as from my own experience, and the reader will find confirmation of several of them in what is still to follow. Not only are there curves encirling both hemispheres of the brain, but systems of curves in each hemisphere. Persons of psychological power can sometimes throw these curves of force around others at a great distance and influence them. An eminent German singer informed me that he had often made persons turn around while forty yards away,

and a New York gentleman of my acquaintance often amuses himself and a friend, who is with him, by willing and causing ladies at some distance ahead of them, to turn around so that they may view their countenances, and says he can generally tell what ones he can influence thus, and what ones he cannot affect. I could give various examples of ladies who have the same psychological power, especially those who possess health and vital force. A man is a magnet, only of a higher grade than magnets of steel, having power to attract and repel sensitive human beings just as the steel instrument can attract its like, only with a compass a thousand times as far-reaching.

9. *Perversions of Psychic Forces.*—All things, however excellent, can be perverted, and the grandest things can sometimes be perverted the worst if people will remain in ignorance of their real nature. A flock of sheep will wear certain pathways and then travel in them even if it takes twice as many steps to reach a certain point as it would to move in another direction; and so human beings have carved out in their own mental and psychological conditions, ruts of all kinds, such as the medical, religious, social, and political, and are ready to fight almost to the death those who dare to chisel out any other style of ruts than their own, and especially those who, emancipated from such slavery to old opinions, dare to stand upon the mountain top in God's free sunlight and welcome all truth, however contrary to preconceived opinions. There are always some men and women that can be psychologized to believe anything under heaven, however monstrous, if only persons of some ability or magnetic power shall earnestly inculcate it. A gentleman once made some children cry out of sympathy for "a poor broomstick that had been left out in the cold and snow all night alone," while millions of grown-up children are easily made to believe that certain persons are prophets or vicegerents of God who have a right to tyrannize over them. A community of the ignorant class of Europeans, settled in Illinois, have a leader who professes to be God himself, and is revered and obeyed as such by the people, who dare not even marry or do any other important thing without his permission. What hundreds of millions of Brahmans, Buddhists, Mohammedans, as well as one thousand different Christian sects, are absolutely sure that

they alone are right, while perhaps their neighbors, who may be better in life and practice than themselves, are doomed to destruction because they do not walk in the same rut of belief. As people become broad in their culture, and their intellect gains control of their impulses, and they attain the grandeur of a free manhood and womanhood, they will learn to weigh all things in the scale of reason and not be governed so slavishly by the psychological bias which has been fastened upon them in the helpless and plastic period of childhood.

But how many cases of bargain and sale take place in which one party is unconsciously misled by a kind of psychological spell thrown over him by the other party. How many marriage contracts are made under the subtle charm, as it were, of the aura which the parties throw around each other, unconsciously perhaps, or which the more positive party may throw around the more negative, possibly with wrong intentions. What multitudes of seductions are thus brought about. For this reason all should become skilled in these fine and mighty agencies, should know their laws and be able to hurl back indignantly all base influences that shall be attempted, or if they are physically too weak at once to do this, they must grow strong by means of light and air and exercise and the help of vital magnetism.

XII. The Right and Left Brain, etc.

1. *It is the usual law for the blue and violet streams of the electrical psychic forces to sweep into the left side of the head and out at the right, both in curves and straight lines as we have just seen.* There is a coarse animal magnetic sphere of radiation in the case of all persons, extending usually some three or more feet around the body, but these finer soul forces often extend many miles, and can be thrown by a powerful volition hundreds of miles, as can be thoroughly proved by facts. Mental telegraphing between sensitive persons has taken place at a great distance apart. M. Dupotet magnetized persons at the Hôtel Dieu, Paris, through a partition, by simply using his will, and that in the presence of very eminent physicians who admitted the fact, while in various cases which have taken place in this country and elsewhere, magnetizers have put their subjects to sleep while many miles distant and while walking around

engaged in their daily duties, entirely unconscious of what was to be attempted. How much imagination is there in such cases? Mr. J. Mendenhall, of Cerro Gordo, Indiana, stood a number of rods behind a wood-chopper, unseen by him, and using his will powerfully, gradually made his strokes grow less and less frequent until at last the uplifted axe was stopped in mid air and the man stood like a block of marble transfixed by these mighty streams of force. The stronger magnetic flow from Mr. Mendenhall entered the brain of the chopper, became master of his nerve channels, and through them paralyzed his muscles.

2. The *left brain* is the portion especially strong in the interior forces, especially potent in discovering the properties, relations and proprieties of things, and thus, being the receptive brain, must naturally be more skilled in its intuitional character, while the *right brain* is the realm of positive efflux power, of executive skill and of vitalizing character. This we might naturally expect to be the case from knowing the law of the influx and efflux forces. Dr. Brown-Séquard has shown that memory and intellect and the perception of how to control the tongue and larynx and muscles of the chest to produce articulate voice, and the remembrance of how to use the hand in writing words, come more from the left than the right brain, while the right brain "serves chiefly to emotional manifestations, hysterical manifestations included, and to the needs of the nutrition of the body in its various parts," and "has more to do with organic life." If disease attacks the right side of the brain, paralysis is much more apt to take place than when it attacks the left side, which accounts for the fact that paralysis occurs on the left side of the body more than on the right side, as the right brain rules the left side of the body, and the left brain the right side of the body. The left brain causes right-handedness, and the fact that it rules the more masculine, or positive side of the body, shows that of itself it is more feminine, being the chemical affinity of that side. When Dr. Brown-Séquard talks about our having one side of the body developed up to the same strength and skill as the other, he seems to be unaware of the fact that positive and negative conditions must forever rule in nature, and can never be wholly obliterated.

XIII. Radiations and Laws of Power.

1. A beautiful lesson can be drawn from these radiations from the different parts of the head, a hint of which was given in Dr. Buchanan's Anthropology. Each part of the head radiates more or less in all directions, but the plate gives simply the predominant direction. Notice the lines of polarity extending from the perceptives. Their direction is somewhat downward toward the earth and their leading purpose is to take cognizance of the outer world to mirror forth the material conditions around. Their color is blue, indigo and violet as they move earthward, but the very lines of polarized atoms which carry these colors *to* the earth, have an especial affinity for the red, orange and yellow which emanate *from* the earth towards the perceptives, and which, being of the luminous order, are especially fitted to reveal the character of the objects from which they proceed. A little higher are the radiations from the domain of Reason which point upward, downward and forward as if to weigh and balance all things above and below. The moral and spiritual faculties radiate principally upward, and drawing their inspirations from the celestial, tend to lift man above the grossness of earth. The radiant yellow emanates principally from the median line and comes from the higher portion of both the right and left brain. Firmness with its co-operative elements of Energy, Integrity, Patience and Hardihood, sends upward a shaft of blue electricity, a portion of which comes doubtless from the spine, thus holding the body and mind up to a rigid polarity of forces which, when strong, will bend neither to the right nor the left. Self-Esteem sends its purple light partly upward and partly behind, and tends to draw the head backward, just as Benevolence and Reason, as balancing principles, tend to draw the head forward, and lead to the esteem of others. Firmness, Self Esteem, etc., are the executive forces of volition and can never lead to selfishness or wrong, if balanced by the coronal and frontal developments. Below and behind are the more violent passional developments with their red phases pointing mainly downward. These are in the lowest and darkest parts of the brain, but although placed thus in the most inferior part of the scale of being, they have their divine elements of use which, when

regulated by their opposite polarities on the other side of the head, become harmonious and good. The trouble is that mankind in its average present grade of development, constitutes this animal portion the captain of the ship, while nature has placed Reason at the helm and the Spiritual Forces at the highest lookout above the whole.

2. *The great law of perfection in human development is to have a harmonious balance of all the faculties.* The back head has great propelling power and must be active in order to vitalize the body and give physical force, but if not cooled, refined and guided by the front and upper brain, the forces become too gross, over-indulgence and warmth burn out and exhaust the system, and the end is fearful suffering, insanity and death. This sort of preponderance fills the whole brain with a cloudy red, and colors all thoughts and sentiments until truth and purity finally become impossible. On the other hand, however beautiful Reason and the Inspiration of the upper brain may be, their excessive development to the neglect of the lower brain will draw the forces too much away from the body, and by exhausting the physical system lead to disease, insanity or death. The disease and insanity caused by the over use of the higher brain, is however of a milder kind than that caused by beastliness. *We do not want a blue brain, or red brain, or yellow brain, but one which like the union of sky, water and landscape, gives us the beautiful diversity of nature. Holiness, or wholeness includes the full development of the Perceptive, Reasoning, Esthetic, Spiritual, Social and Animal man, the deficiency of any part of which leads to unholiness.* Tried by this standard we see that asceticism, exclusiveness of religious devotion, intellectual culture or excessive animal desires are each and all but different grades of unholiness and onesidedness.

3. *The greater the radiation of the Vital Ethers to any one place, the more the blood is drawn there as a general rule, and hence the greater the increase of the tissues, and consequently of the size.* Thus if the muscles are used, the vital magnetism and blood cause them to increase in size; if the psychic ethers are drawn to the forehead by the hand or by study and thought, the Reasoning powers increase in power and the forehead becomes more prominent; if the Perceptive powers are animated by

vital ethers from the fingers or by constant observation they will enlarge the prominence of the ridge above the eyes. I knew a young man who increased the circumference of his head, measured around the eye-brows, a half an inch by one year of travel and observation. The treatment of the Moral, Spiritual and Esthetic Faculties on the same principles, will give the forehead and upper head, a higher, broader and nobler appearance. Other portions of the brain may be increased in the same way by mechanical appliance of the hand, the fingers being highly magnetic, and by psychological use of the faculties. We should remember, however, that some persons may have much intensity and power in certain phrenal organs without necessarily building those organs up into a large size, from deficiency of their nutritive system.

4. *The emanations from the brain are not always seen as straight lines of radiation*, or in just the appearance given in the plate. If the brain observed is absorbed actively in thought, the blue element for the time being will swallow up the other colors; if love, or the emotional elements are most active, a red cast will predominate. A lady informed me that as she observed a public orator, a great variety of brilliant and flashing coruscations of every kind of color made their appearance. Sometimes under the excitement of powerful thought and feeling, a thousand flashes of light are seen around the head, caused probably by the explosion of brain cells brought about by the chemical action of the psychic ethers. If these cells thus destroyed by mental action during the waking hours are not replaced by sufficient food and sleep, the system begins to decline.

5. *The Ganglia* or knotted portions of certain nerves are seen clairvoyantly to emit explosive flashes of light, especially when the forces of a nerve are excited into action, as by pricking or pinching the flesh. Suppose the flesh to be pricked by a needle. The animal electricities being aroused flow in streams of light towards the brain in the pathway of the sensory nerves. When a ganglion is reached an explosive action takes place, caused by the chemical affinity of the bluish white nerve fibres with the reddish gray matter in the ganglion. What is the necessity of this ganglion? One advantage of its existence seems to be that it continues the action which has already been commenced by the needle with all the

more distinctness to the brain. The merest touch of the foot with a hair starts a stream of vital flow which may not be sufficiently strong to go all the way unassisted to the brain in a way to produce sensation, but coming to a ganglion, the chemical action intensifies the stream and the effect is the more easily accomplished. This is nature's method of economizing her forces, for were it not for the ganglia, the apparatus for producing an equal degree of sensation would have to be more complicated. The interior ganglia of the sympathetic nerves must also produce a very vitalizing effect on the surrounding viscera. Fig. 188 will show how the nerve fibres pass through the nerve cells of a ganglion, thus bringing the bluish gray and reddish gray matter into connection so that chemical affinity may produce its explosive action and send the currents of nervaura onward to other centers.

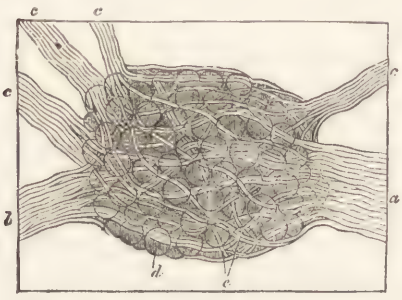


Diagram of Ganglion.—*a, b, c.* Nerves. *d, e.* Cells.

Fig. 188.

6. Reichenbach and others repeatedly describe the streams of light which radiate from the ends of fingers, or of a magnet, or of a crystal, or from the angles of a substance. The human system has not only its centres of luminous action where masses of nerves are found, but also from its angular or projecting portions, on the same law that electricity is known to gather at points rather than at the larger expanses of surface. This fact will be shown in figs. 189, 190, 191, which I take from Guillemin's Forces of Nature. The sphere shows a diffused electricity over its whole surface, the ellipsoid shows the increase of electrical tension near its narrower portions, while a flat disc shows a still stronger tension at its edges. A bar or tube would perhaps show a more intense electrical action at its ends than

Fig. 189. A Sphere.

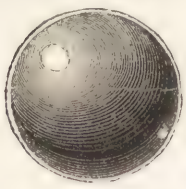


Fig. 190. An Ellipsoid.

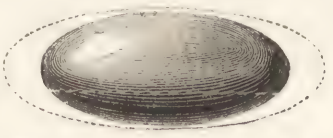
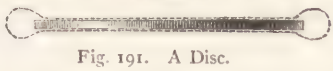


Fig. 191. A Disc.



the disc. These facts will furnish a hint of how it is that nature, in building up the human system, has sent the nerve ethers out to the ends of the fingers, tip of tongue, etc., with such an intensity as to carry a large amount of their affinitive nerve matter with them in the shape of tactile corpuscles, by means of which sensation becomes so acute. As streams of water, rushing to any particular point tend to carry the soil and other light substances suitable to its style of power along with it, until it builds up its little points and promontories, so will streams of nervaura, assisted by the galvanic action of the blood, sweep nerve cells and tissue more and more outward until a projection called a tongue or other organ is formed. Thus is the fluidic theory ever coming to our aid in the solving of mysteries, and making difficult things more simple.

XIV. Intuition, and the Relation of the Sexes.

1. Now at last we may understand the mystery of Intuition, that wonderful method of reasoning by means of which the mind is said to mount at once to the top of the ladder, and come to definite conclusions without going up the intermediate steps. In the usual methods we reason by the aid of comparatively slow and coarse ethers; in the case of Intuition, we come into more direct use of these amazingly fine and swift ethers, by means of which our thoughts can move on the wings of lightning. No links in the chain of reasoning are omitted, but the mind dashes through them so rapidly that it is impossible at times to remember them all. This is woman's favorite method, and the fact that she gets into rapport with the fine forces more easily than man is the reason. In mathematical demonstrations and slow laborious reasoning, man is the superior. In the impressions of truth which flash upon the mind in a moment, woman is the superior. Coleridge once had a lady of fine intuitions in his family, and having got into a difficult maze of thought left the study and asked her for her first impressions on the subject. She immediately answered him, and commenced telling her reasons for her opinion, when Coleridge, interrupting her, said: "Never mind the reason, Madam, I will find out that when I get into my study." I have myself submitted to certain intuitive ladies dif-

ficult questions which they had never considered, their first impressions of which would be correct, but in some cases I found I could confuse their minds and lead them to doubt by presenting arguments on the opposite side.

2. While the *Education given to Women* is even yet much inferior to that which men receive, thus leaving her mental faculties less perfectly developed than would be desirable, yet by means of her intuitional nature she possesses various advantages over her masculine competitor. Applying this remark to only one subject it is safe to say that if medical science had sooner received the co-operation of women with their quick practical insight into conditions and their sympathy with suffering, we should not have had so diseased a world as we have to-day, and a more common sense system of methods would have been adopted.

3. The Sensitives of Reichenbach always perceived much longer and larger odic flames around men than women. Miss Reichel saw flames from the tips of all men's fingers darting up and down like other flames, but women's fingers emitted little or no light, and her own, especially, no light. This signifies that *woman's forces, being more negative than man's, are more of the influx order, while the latter is stronger in his efflux radiations. All forces from surrounding conditions are received into the system of women more than into that of men, which accounts for their sensitive and sympathetic natures.* The fact that the sexes are thus constituted on the plan of positive and negative forces shows why it is that when they dwell in each other's atmosphere they often find themselves refreshed, strengthened and harmonized, as each intensifies and balances the action of the other. It can be proved that boys and girls, educated in the same schoolroom, grow stronger, wiser and better than when educated apart.

4. In woman's lower occiput and chin the love forces manifest themselves in the red tint as in man, but with somewhat less of the dark element.

5. Another mystery is made clear by these Psychic forces. It has often been a matter of wonder that *women in spite of their physical weaknesses live, on the average, longer than men,* as shown by statistics. In speaking of statuvolence, we saw the remarkable power over both disease and mental conditions which persons could wield in proportion as they went into the condition.

Woman in her weakness may bend like the willow, but being able to call the swift forces to her aid more easily, can weather a storm which would sometimes destroy a man. In the sick-room, or in a severe siege of suffering she is ever the mightier of the two ; and suicides are far oftener masculine than feminine, which looks much as though the latter had the greater moral courage.

6. It has puzzled Dr. Brown-Séquard somewhat that *Americans are longer lived,* as he admits, *than the people of European nations,* especially as they do not seem so sturdy as their brothers over the water. This cannot come wholly from the universality of education among our people, for Prussia, perhaps, can even surpass us in that respect. If we remember the nervous activity of our people, which makes the movements of other people seem rather slow to us, we may easily understand that these finer ethers must have a considerable prominence among us, and hence the power of recuperation. Our business men and our politicians in their fierce rush for pelf and power, should remember that when these active forces are too constantly used without sufficient rest, they are liable to burn the system entirely out and make wrecks of themselves physically as well as morally.

7. The *Wonderful Rapidity of Mental Action* possessed by certain persons is easily accounted for by the fact that these interior forces, when brought into predominance, must necessarily make all perceptions remarkably swift and clear. Zerah Colburn when a boy, could in a moment multiply in his head a number requiring six figures to express it by another equally large, and young Safford, of Massachusetts, now Professor in a Chicago College, when only nine years old would multiply still larger amounts together, while whirling around on his heel in an intensity of excitement. At the same age or a little later, he would calculate eclipses mentally, and that by methods one-third shorter than those in ordinary use. Mr. Hutchins, of New York, known as the "Lightning Calculator," in the process of addition, can sweep immense columns of figures on a blackboard from top to bottom, almost as swiftly as the shooting of a meteor, and give a correct answer before any ordinary eye can even see the figures to read them. But this amazing velocity of mental action cannot be practiced with safety too long at a time, and great pre-

cocity in children must be guided with care, and a powerful physical system built up to prevent the blaze of thought from burning up both brain and body. Safford, when a mere boy, was handed over to the care of Harvard Professors, and was thus guided with sufficient wisdom to prevent his premature death.

8. *The power of using these fine forces in the process of clairvoyance, etc., is supposed by many superficial students of this subject to betoken weakness and disease.* Never was a greater mistake. While it is true that some delicate and diseased persons, from having almost none of the coarser forces to interfere with the finer, are able to see clairvoyantly, yet many clairvoyants entirely lose their power when they become sick, and I have known many persons to rise from a condition of ill health into great power as they cultivated and received these influences. A lady in New York who treats patients by powerful manipulation and giving out of the life power all day and nearly every evening until midnight, for weeks or even months in succession, is more or less clairvoyant all the time, feels the fine fluids animating her whole system, and is a superb specimen of physical power. Some of the most powerful men in the country would be like wilted leaves if they should attempt such an exhausting practice for three days. My own case is an example in point. Before cultivating these subtler agences, I was often sick, sometimes dangerously so. Since I have learned how to receive and use them, I have possessed a very strong physique and have never been sick a day. My weight is 180 pounds. One of the best clairvoyants in the country is a Mr. Wilson of Illinois. He is almost a giant in size and power, weighs 265 pounds, and is never sick. I could quote a multitude of similar cases, some of whom possess a marvelous stock of vitality and force. Is it reasonable to suppose that the most powerful forces, like these fine agencies, compared with which the common coarser life currents are slow and sluggish, will have a tendency to weaken? Never, if managed with any care, for the mind, if persevering, can easily learn how to hold them under rigid control, bidding them when, where, and how far to go and making them mighty for good. The truth is that nearly all have untold treasures of power locked up in the inner being, in fact are *millionaires*, but their priceless treasures will remain

useless to them, until some one informs them of their own possessions, and hands them a key with which to unlock them. For this reason I have written this volume, striving to reveal to dear struggling humanity, whose interests I would ever subserve, the blessed qualities of that light which illumines external nature, and the still holier light of man's inner temple where dwells immortal spirit itself.

XV. Positive and Negative Poles.

1. As has already been stated the positive poles of the human battery are generally in the head, and the negative poles in the body. Up to this time I have not been able to get a very clear view of the colors of the body, but in the lungs orange and red are well developed, and to some extent the yellow; in the stomach I think the ruling color is yellow, with a sufficient amount of blue to give it a yellow green cast. The sexual organs are surrounded by a reddish brown, being of a somewhat darker cast than the region of amativeness on the head. The position of the negative poles on the body corresponds very generally with the position of the positive poles on the head, the front and upper head matching the front and upper body, etc. It will be seen that the color of the lungs constitutes a chemical affinity with that of the forehead and bridge of the nose, which connect so directly with the breathing apparatus. Amativeness, with its red elements, corresponds with the bluish portion of the lower spine, which is its negative point of manifestation, etc.

2. Since writing the foregoing I have received through the inner vision of Mrs. Dr. Somerby, of Syracuse, a full confirmation of the points there stated, together with still other points. Mrs. Somerby remarks that she first began to observe these psychic manifestations of color in connection with human beings, at a time when two gentlemen who sat part way across the room from each other were engaged in a warm argument. The one was somewhat dark and rubicund in complexion, and strongly of the arterial or vital temperament; the other was pale, slender, and more intellectual. The former would send out coruscations of light which was tinged with red, thus reasoning, as it were, from the blood and from his emotional na-

ture; the other more cool and surcharged with thought, would radiate blue emanations towards his opponent. She was greatly amused at seeing these emanations darting back and forth and sometimes clashing.

I have taken down the following from her description of the colors of the human body:—The central portion or pole of the brain was described as being very brilliant like a sun, or a calcium light; the stomach was pronounced a deep yellow; the lungs, yellow and orange; the heart, a dark red; the bowels, yellow, with the lower part greenish mixed with some red; the back lower brain, a dark red which merges gradually into bluish white as we move down the spine; the spine, a bluish white as the ruling color, with also a reddish or reddish brown cast at the lower part, while in fact the whole nervous system showed streams of bluish white light coursing through all its channels, just as the arteries exhibited currents of red light, and the veins a grade of color less luminous than the arteries. Pointing to the pit of the stomach beneath which the solar plexus and semi-lunar ganglion lie, she says she saw all the colors radiating in brilliant rainbow style, and remarked that by placing a magnetic hand there it would have a healing effect on all below it, but not so much above. She saw a considerable variety of color in the region of the hypogastric plexus also. She saw different poles at the heart, liver, the bottom of the feet, etc. The feet send out quite a variety of colors with the warm colors in predominance, just as the head, being the opposite pole, on the plan of a bar magnet, has a variety of colors with blue predominating, especially at the back and front upper portions.

XVI. The Interior Machinery of Life.

1. Henry Hall Sherwood, M. D., of New York, a man of scientific culture and original force of thought, published works in 1841 and 1848 on the *Motive Power of the Human System*, which being too much in advance of his time to be appreciated, are now out of print. I have in my possession a fragment of his leading work which is considered so remarkable that a physician has offered ten dollars for it. By the aid of clairvoyants he was able to penetrate more deeply into the philosophy of life

than most others, and made numerous experiments in magnetism and electricity which confirmed the revelations of this clairvoyance. I will give in fig. 192 a general view of the interior radiations of the brain as seen by his experts. It represents a section as cut from the upper part of the forehead at the organ of Causality, *a b*, through the brain longitudinally, sloping to the lower occiput through the cerebellum, thus bisecting the organ of amativeness, *c d*. Five great leading poles were discovered, one very splendid and powerful at the center of the brain in the third ventricle, one each side of the forehead, *a b*, constituting the two sides of Causality, the central reasoning function, and one in each portion of the cerebellum, *c d*, constituting Amativeness, or the function of procreation and certain motor impulses. Minor poles were also discovered in each of the other organs of the brain, between which and the great central pole were constant radiations. The outer convolutions of the brain in which the organs are situated, are reddish gray, the inner mass of the brain is bluish white, and has a vast number of fibres or striæ which radiate outward in all directions, as conducting lines doubtless for the interior ethers, and the third ventricle at the center is also bluish white, which according to the laws of chemical affinity must cause an admirable harmony and activity between this center and the reddish gray matter of all the organs in the outer brain. The anatomy of the brain shows that there are special striæ radiating from the front brain corresponding to the organ of causality, and others corresponding to the organ of amativeness. The two stars between the organs of amativeness in the cerebellum, were seen by the clairvoyants to have much to do in regulating the motions of the body in harmony with the discov-



Fig. 192. Interior Radiations of the Brain.

eries of physiologists, though not the only ones that operate thus.

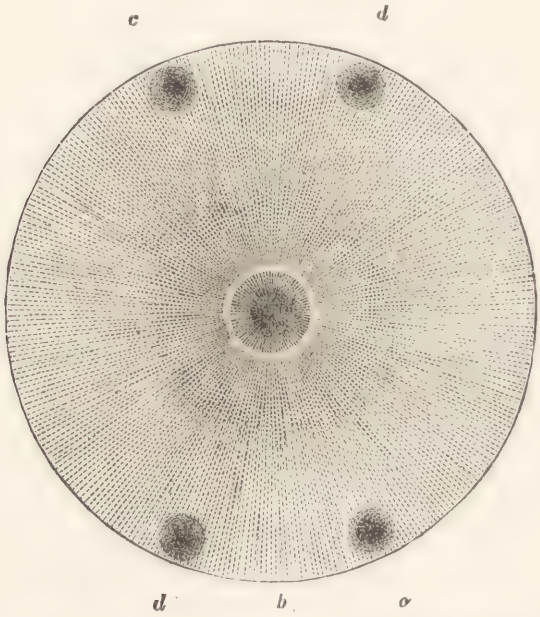


Fig. 193. A magnetized Steel Disc sprinkled with Iron Filings.

2. This system of the brain in which five leading centers were discovered both in its physical structure, and in its luminous radiations, was shown to be in harmony with the forces of inorganic nature by Dr. Sherwood, as follows :—" This was seen to be an extraordinary number and arrangement of the poles, as we have been accustomed to the number and arrangement of two poles only —of a positive and negative pole. We must therefore see whether the magnetic forces would of themselves, without artificial aid, produce five poles in this order of arrangement, and for this purpose we may use a circular plate of steel which would correspond with a middle horizontal section of the brain. A circular saw plate eight inches in diameter, and the tenth of an inch thick, with a hole in the center of one inch in



Fig. 194. Geo. Combe. The Phrenologist, representing the Location of Causality on the Forehead.

diameter, was accordingly subjected to actual experiment in the following manner:

"The middle of the plate or disc was carefully let down in a perpendicular direction on the middle of the positive pole of the galvanic battery, and after having remained there a moment, was raised from its position in a perpendicular direction, turned over, and the opposite side of the plate placed upon, and then removed from the negative pole of the battery in the same manner. The plate was then covered with white paper, and fine iron filings were strewed over it, and they were immediately arranged by the forces in the plate in the manner seen in fig. 193.



Fig. 195. The Brain laid open. AA, Anterior portion; CC, Ganglia of the Cerebellum; EE, Corpus Collosum; A, Third Ventricle; 1, 1, Great Superior Ganglia; 2,2, Great Inferior Ganglia; 3, Interior of Fourth Ventricle; 4, Medulla Oblongata.

"This experiment was repeated eleven times on plates of from four to fifteen inches in diameter, and always with the same result. It may therefore be inferred to be constant. It presents one large and strong pole in the center of the plate, and four smaller and weaker poles in the circumference, like those in the brain.

"On applying the dipping needle to these poles, that in the center and those in the circumference at *cc* were found to be positive, and those at *dd* negative poles. When, however, the order of magnetizing on the different poles of the battery was reversed, the character of the pole in the center was changed from a positive to a negative pole, and the positions of the positive poles in the circumference were also changed; the positive occupying the positions of the negative, and the negative those of the positive poles."

This last arrangement would be an exact representation of the poles of the brain as seen by the arrows in fig. 192, although the

great central pole must combine the character of both the positive and negative conditions, as it receives forces from all quarters internally, and radiates them to all quarters externally. Fig. 195 shows two radiating centers BB, with striations in all directions, situated in the anterior portion of the brain; also the two centers of physical life CC situated in the cerebellum, together with the location of the third ventricle A, etc.

3. *The Poles of the Body.* Dr. Sherwood had a lady, who had been blind from her infancy, examine the whole system while in the somniscient state, as he calls it. He says her "extraordinary revelations excite the greatest astonishment among anatomists and physiologists," and she could not have read Dr. Sherwood's mind for she had her own positive vision of the interior parts of the body more clearly even than could be impressed upon her by those present, and sometimes differed from them and taught them. She could see the five leading poles of the brain, could see lines of light running along the nerves, could see bright spots or poles in all the ganglia and in all the organs of the body. What was curious was the fact that she would send fresh illumination into an organ by placing her own fingers over it and by getting Dr. Sherwood to place his fingers over certain parts of the spine which had nerve connections leading to it. Thus when she was asked to examine the left lung and heart, she placed Dr. Sherwood's hand "on the left side of the space between the last cervical and first dorsal vertebra," and then her own hands over the front of the chest. To examine the liver she would kindle the interior light so that she could see it the better by placing the Doctor's hand "on the right side of the space between the seventh and eighth dorsal vertebræ." Another lady examined the poles of the body clairvoyantly "with precisely the same result. She confirmed in the most minute manner the number and situation of the poles in the brain, lungs, heart, stomach, pancreas, plexuses, mesentery, liver, spleen, kidneys, uterus, ovaries, tongue and orifices, and the connection between the left kidney and spleen, and also the connection between the uterus and breast, etc. Mr. Sunderland then commenced an examination of the joints of the limbs and spine, each of which she said had too poles, the one for extending, the other for

flexing the body and limbs, when he commenced demonstrating the fact, by exciting the different positive and negative poles of the elbow joint, situated at the points of the insertions of the muscles, one near the upper and the other near the inner side of the condyle of the humerus, when she would extend and flex her arm alternately by exciting in the slightest manner the different poles."

"He then held the point of a pen-knife near the organ of Causality, on the right side, when she began to move her head from it. He then held it near the same organ on the left side, when she began to move her head toward it, and on inquiring the cause of her doing so, she answered. 'It pulls, oh! take it away.' He then held the point of the knife near the organ of amativeness on the right side when she again observed 'it pulls.' He then held it near the same organ on the left side, when she soon began to move her head from it, and on inquiring why she did so, she observed, 'it pushes.'"

This confirms the statement which I have already made that the forces sweep into the principal brain from the left side, which thus by their suction drew her head forward in a way to make it pull, while they pass outward at the right side in a way to make it push. In the back part of the small brain, called the *cerebellum*, the forces move in just the other way. The doctor has well represented these currents by the direction of the arrows in fig. 192. I will now quote Dr. Sherwood's synopsis of the number of the poles in the different organs as signified by these young ladies, and also as signified by two boys and one young lady examined by Mr. L. N. Fowler, the Phrenologist, while they were in the somniscient state.

"*Number of Large Poles in the Organs.*—Brain, 5; eyes, 2; ears, 2; lungs, 2; heart, 5 (like the brain); stomach, 2; liver, 2; spleen, 2; pancreas, 2; kidneys, 2; bladder, 2; uterus, 2; ovaries, 2; vagina, 2; breasts, or mammæ, 2; solar plexus, 2; mesentery, 2.

"The *Orifices* have each one large pole, namely:—Tongue, 1; larynx, 1; pharnyx, 1; cardiac orifice of the stomach, 1; pyloric orifice do., 1; ileo-cœcal valve, 1; anus, 1; and 1 in each convolution of the intestines.

"The *Ganglions of Vegetative Life*, or those connected with

the great sympathetic nerve, including those of the solar plexus, have each one small pole.

"The *Ganglions of Phrenic Life,* or those of the brain and cerebellum, including the olivary bodies, and ganglions of the spinal nerves, have each one small pole.

"*Secreting System.*—The lymphatic glands of this system, including those of the mesentery, have each one small pole. These poles are alternately negative and positive, and not only secrete a fluid in these glands, but change its negative and positive character alternately, and at the same time attract the fluid secreted along the lymphatic vessels to the heart.

"*Excreting System.*—There are no poles discovered in the mucous glands of the mucous membranes or in the skin, in the somniscient state, but numerous nerves are seen to terminate in these membranes and in the skin.

"The *Convolutions of the Brain,* or phrenological organs, have each one small pole."

4. *The Direction of Human Polarization.* Faraday says man is diamagnetic, *i.e.* if his body should be suspended from a pivot between the poles of a great horse-shoe magnet, it would not arrange itself in the magnetic meridian, with the head at one pole and the feet at the other, but at right angles to this direction, or in the magnetic equator. This would show that the strongest forces are transverse and agrees with Reichenbach and with my own experience, the front and right side being positive, while the back and left side are negative. Sherwood thinks the lines of polarity in man are between the head and feet. That there are such lines is doubtless true, but the transverse lines seem the strongest and are very distinctly indicated by the opposite poles of color. We have seen that the lower occiput reverses the order of currents which prevail in the front head, the influx or negative currents being at the right, and the efflux currents at the left. This may occur from the fact that the right and left hemispheres of the brain decussate at the region of the *pyramids* (*corpora pyramidalia*) and carry some of their influences to the cerebellum. The legs have been compared to a horse-shoe magnet, the positive pole of which is at the right foot; the arms to another magnet, with the positive pole at the right hand, while the fingers of each hand and the toes of each

foot constitute a series of magnets. Thus the human body is diamagnetic as a whole, but magnetic in its parts. The fact that the heart is located somewhat towards the left part of the body, may have had an influence in bringing the red thermal light on the left and the electrical colors most strongly to the right. On account of the polarization of these different magnets of the body many sensitive persons find that they cannot cross their own hands or legs without interfering with the regular play of forces and causing uneasy feelings. Reichenbach states that M. Schuh, a physicist of Vienna, will have a headache if he puts right and left hands together a few minutes, while some are so feeble and sensitive as to go into spasms when hands and feet are crossed.

5. *Muscular Action.* Physiologists are much puzzled by the fact that nerves of motion, or those that act upon the muscles, and nerves of sensation which carry the vital ethers towards the brain, are composed of exactly the same material. The etherio-atomic law makes this clear, and shows that the same material can conduct both the thermal and electrical forces, and also the same kind of forces both ways, and as the nerves are but the wires which connect the different poles of a battery, the principal effects which are communicated through them depend not on the conductors but on the elements and forces at each end. Thus if the reasoning forces of the front brain in which motor nerves are in predominance should decide to close the fingers, they can instantly, by causing an explosive action at the poles, send an electrical force through the motor nerves which connect with the flexor muscles and it will cause these muscles to contract and bend the fingers. Why will it *contract* the muscles? Because it is electricity, not the coarser grade, but vital electricity, for every grade of electricity is contracting in its nature. To intensify this electrical action all muscles are provided with a mucous membrane and a serous membrane, the former having a predominance of alkali, the latter of acids, and both acting as the opposite plates of a galvanic battery, the blood being the connecting fluid. At the same time the brain sends down a thermal force to the extensor muscles on the opposite side of the fingers which, of course, causes them to expand, as all thermal action is expansive. This point will be explained more in detail in a future work on Human Development.

XVII. Processes of Mental Action.

1. *Thought and Feeling.* We have already seen that thoughts, emotions, etc., cause a great rapidity of action among the ethers of the brain, thought sending its blue radiations, love its red, etc. This by no means signifies that we can see thought, but simply the action of some of the coarser ethers which its processes awaken, and demonstrates also that no mental action is possible without motion, or in other words without some active instrument through which it works. Dr. Sherwood's somniscients saw streams of light going to and from the great central pole of the brain while thinking, and also lines connecting with each other. The outward world radiates its light, including colors, forms, sizes and motions upon the mind through the eye, its voices, tones and sounds through the ear, and many of its subtler forces directly into the brain itself. These may be supposed to pass on to the central pole and by that be reflected to all quarters of the brain, so that each faculty can take cognizance of them and pass its appropriate verdict. Suppose for instance a choice stone has been discovered. Its image is carried first to the retina, then modified and carried to the central pole, then reflected to the various organs or gray convolutions of the outer brain for them to pass their decision upon it, such as that of Form which takes cognizance of its shape, and Color which discriminates with reference to its tints and hues, and Acquisitiveness, which considers its value as a possession, and Ideality which considers its beauty, and Comparison which measures its qualities with other similar substances, and Causality which traces out its origin, laws of formation, etc., and Benevolence which asks what good can be done with it? and so on, the fine ethers echoing and re-echoing from center to circumference, and from circumference to center of the brain, and making their impressions on the inner tablets of the mind just as really as impressions can be made in plaster of Paris. That this play of mental forces has a reactive effect on the whole system is too well known to need illustration here, as physiology shows how the fibres of the nerves pass through the medulla oblongata and elsewhere to the heart, lungs, stomach and all the other viscera, producing sometimes an animating and sometimes a depressing

effect, according to the nature of the force communicated. Persons of violent impulses will frequently have the lower and back brain in such a hot and perhaps diseased condition as to radiate their ethers powerfully over the front and upper brain, and thus becloud and overpower the voice of both reason and conscience in case of any excitement. Such are not to be cured by severe means, but by remedying the physical and psychological causes of the difficulty. We need fewer prisons and more institutions that shall combine the character of a *work-house*, *hospital* and *school* in one, for sick minds should be treated as tenderly as sick bodies, if we are ever to save the world, or in other words, sick minds always include sick bodies, or imperfect bodily conditions, for we cannot have a thought or an aspiration, or even an inspiration while in this life, without using a physical brain and physical aura as the negative instruments.

2. *Psychometry*, literally *soul-measuring*, is a term adopted by Dr. J. R. Buchanan over a third of a century ago. It recognizes the fact that all things radiate their own character upon all surrounding objects so that sensitive human beings can often describe them minutely. Thus Prof. Denton gives an account of two ladies who, on holding a piece of matter from the ruins of Pompei, saw belching fire and smoke and seemed to be almost frightened at the excitement and turmoil which was indicated thereby, and this when the object was covered with a paper and they were entirely unconsious of where it came from. Dr. Buchanan has shown in many cases in his lectures before medical classes, how drugs merely held in the hand, will produce the same symptoms on most persons that they would if taken internally, only in a milder form, and has found in very many places, persons sufficiently sensitive to read the character of another from an object which they have handled, especially from a letter which they have written. Bayard Taylor, the celebrated American Traveller, who has had a vast experience in observing mankind, writes as follows to the Cincinnati Commercial, of Mr. Brown, the Mind-reader: "Mr. Brown, is giving what he calls 'mind readings' at Chickering Hall. It is nothing but a marked instance of natural clairvoyance—a power which, in greater or less degree, is known to at least one-tenth of the civilized human race. But the materialistic philosophers are bent

upon giving a purely materialistic explanation of the phenomena; and it is curious to what incredible lengths they go, in order to avoid admitting the existence of a 'spiritual sense.' The last explanation is that Mr. Brown is a 'muscle reader'—that is, that he detects from the muscles of the face the particular thought, name or object in the mind of the person which he professes mentally to read. This is very much like inventing a miracle to account for a natural occurrence. I see nothing extraordinary, or even unusual, in all that Mr. Brown does. In him the sense is more finely developed, but tens of thousands have it in common with him. I know an artist, who, with bandaged



Fig. 196. Vertical Section of the Brain.

eyes, and a letter in a blank envelope placed between his two hands, will presently describe the character of the writer. In one instance, one of his own letters was thus given to him, and the result was such an astonishing, unconscious revelation of himself, his weaknesses and faults of character, that the experimenter hastily removed the letter, feeling that he had committed a wrong." I see by our New York papers that Mr. Brown, while at Chickering Hall, on Fifth Avenue, has lately shown his ability to find any object, secreted as carefully as possible, without leading by the hand the person who has hidden it, and has thus taken the last plank of the carpers from under their feet.

3. *Vertical Section of the Brain.* While fig. 192 gives a

general plan of the lateral radiations of the brain, fig. 196 gives a vertical section of the brain through the reddish gray convolutions, the bluish white interior portion, the great inferior ganglion in the cavity of the third ventricle *o*, the cerebellum *n*, with its arbor vitæ, the cerebellar ganglion 1, and the medulla oblongata *a*, constituting the upper end of the spinal column. The convolutions of the brain here given, representing the functions of intellect, sentiment, etc., are as follows, according to the usual plan, which differs somewhat from Dr. Buchanan's nomenclature :—*n*, Amativeness, or sexual love; 2, Philoprogenitiveness, or love of offspring; 3, Inhabitiveness, or love of home; 4, Concentrativeness, or power to concentrate one's thoughts and forces; 5, Approbativeness, or love of approbation; 6, Self-Esteem, or dignity of self; 7, Firmness; 8, Reverence, or Religious and Spiritual Aspiration; 9, Benevolence; 10, Human Nature; 11, Comparison, or faculty of seeing analogies, etc.; 12, Eventuality, or power of observing actions and events; 13, Individuality, or faculty for observing individuals and existences; 14, Language, or power of remembering words. This, when large, pushes the eye outward and gives it a full appearance. Causality is on each side of 11, or Comparison. Thus we see that these striations extend in every direction and connect with the external brain on a beautiful law of unity and diversity. But there are many other series of striations and modifying portions of the brain which cannot be shown in the cut.

4. *Gray and White Brain Substance.* Dr. John Hughes Bennett, F. R. S. E., speaking of the white matter of the brain, says :—" On carefully examining a thin section of this structure, prepared after the manner of Lockhart Clarke, and steeped in carmine, the white substance in the adult may be seen to be composed wholly of nerve tubes. These become more and more minute as they reach the gray matter of the convolutions, and are gradually lost in it. * * * The gray matter evolves that force or quality which is essential to mind, and the conditions necessary for this are evidently connected with the molecular and cell structure. The white matter, on the other hand, conducts the influences originating in, and going to, the gray matter." (*Clinical Lectures, p.* 139.)

In the foregoing excellent remarks the learned doctor has

evidently omitted a very important factor connected with the intellectual processes, as the gray nerve cells alone cannot "evolve the force necessary to mind," or to sensation. He might have received a very valuable hint from the following, which I quote from Dr. Sherwood's work :—"On a third examination in the same somniscient state, Mr. Sunderland inquired what she felt with, or what the sense of feeling was in; whether in her skin, flesh or bones; when she answered, 'No, it is not in either of them.' What then do you feel with? 'I don't know.' I then took hold of her hand, and when pinching one of her fingers inquired, where does the sensation of pinching go to? 'It goes along up my hand and arm to my head.' How do you know it goes there? 'Because I can see a motion along the nerves from the pole where you are pinching my thumb to the brain. How can you see a motion along the nerves? 'Because it is lighter where it is moving along.' What part of the brain does the sensation go to? 'To the middle of the brain, I believe.' Well, the magnetic forces move along the nerves as you have before described? 'Yes, they do.' Are not the sensations, then, in those forces? 'Yes, to be sure they are.'" Even this idea is not quite exact, as sensation does not come from the magnetic forces alone, nor from the brain cells, but from both combined.

5. *Special Organs for Special Mental Qualities.* The following is from a lecture of Prof. Agassiz, and is in harmony with the opinions of many physiologists of the day :—"The attempt tc localize the mental faculties of men and animals, to connect them with the superior organization of special parts has failed." It is supposed by Dr. Brown-Séquard that there are no special organs for special mental characteristics, any more than the bottom of the foot can be called the *tickling organ.* On this principle a man might have a magnificent dome of thought in his front brain with expansive brows and forehead like a Lord Bacon or Daniel Webster, and it would have no more significance than the low sloping forehead of an idiot, which would be contrary to all human observation. To say that the mind, whose more immediate realm is the brain, has no special organ for *reasoning* with, or for *perceiving*, or loving, or calculating with, is on a par with saying that we can walk without legs, or see without eyes, or hear without ears. Such is the logic, such the exactness of

our men of *exact science*. Phrenology, of course, is too vast a science to have all its details perfected, and like all other departments of human knowledge, must exhibit many imperfections and seeming inconsistencies until the forces of life are more widely understood, but its fundamental principles must be eternally true, and its leading details must also be correct; 1st, because our principal phrenologists have examined multitudes of cases and given their characters minutely while blindfolded; 2dly, the color radiations already described show the variety of powers and qualities in different parts of the brain, and these colors just harmonize with the leading qualities of the brain as discovered by phrenologists; 3dly, all organs of a sensitive brain can be charged with the hand or otherwise, and the subject, without knowing anything of the organ so charged, will manifest its especial quality in the most unmistakable manner. We have already seen how a lady was brought to an insanity of hunger by touching Alimentiveness, and thrown into convulsions of laughter by charging Mirthfulness, and how Dr. Buchanan, in the presence of Bryant, the poet, and others, could produce any mental phenomena he chose by charging different portions of the brain. Dr. Ashburner would arouse uncontrollable passional impulses, even in ladies, while in somniscence by touching Amativeness with the pointed (warm) end of a crystal, while he could immediately change the feelings by presenting the blunt or electrical end to them. I once placed my hand over the religious and spiritual portion of a young man whom I had in a magnetic state, and he uttered a rapturous expression ending with a prolonged "oh!" He saw visions of sublimity and unutterable splendor, but soon his spirit seemed to be so abstracted from the body that he was sinking into a death-like stupor, which I immediately ended by removing my hand, and making upward and outward passes. The late Dr. Elliotson, some years ago, read before the Phrenological Society of London, an account of a young lady, wholly ignorant of phrenology, who, when mesmerized, pointed out the different parts of the brain in which she *felt anger* (destructiveness), *kept a secret* (secretiveness), *felt hunger* (alimentiveness), etc. I will quote some of the account:—

"Upon my exciting her organ of *tune*, she said, 'That makes me feel so very cheerful—it makes me feel like hearing some sing-

ing.' I requested her to sing. She persisted in asserting her inability until I energetically excited *self-esteem*, when she said, 'I'll try,' and she forthwith hummed an air. When her organ of *Color* was excited (in nearly the middle of each eye-brow), she exclaimed with animation, 'Oh, oh! I see green, yellow, purple, etc., such beautiful colors.' If when she was unable to distinguish an object, I excited *individuality*, she instantly perceived it distinctly. The organ called *wit*, or *mirthfulness*, being excited, she fell into a continuous fit of laughter, exclaiming as well as she could, 'I shall die of laughing.' Upon exciting her organ of *destructiveness*, her whole aspect and tone gradually underwent the most marked change; the 'milk of human kindness' gradually turned to gall and venom; she pouted, frowned, threatened, stormed, clenched her fist, and finally became exasperated. Thinking I had gone far enough I breathed upon the organ * to reduce its activity, and she very soon became calm, losing every symptom of anger." The experimenter in this case was a Mr. Gardiner. Under the light of such facts, and of many others, of a physiological and psychological nature, which cannot be mentioned here, the arguments in favor of this science seem irresistible, and of vast importance, as it opens up the true science of man, and shows how to develop human life on a grander scale. It is a wonderful key to the insanities and idiosyncracies of mankind, as it is plain to be seen that when some phrenal organ or bodily organ corresponding with it, becomes over-excited or diseased, there must at once be that overaction of the mental forces developed by it which constitutes a grade of insanity: if the organs of the front brain be demagnetized by passing the currents away from them it develops a temporary idiocy—if other parts of the brain are treated thus, the conception becomes strangely perverted. Dr. Sherwood and Rev. La Roy Sunderland witnessed the case of a mesmerized lady in New York, who, when *tune* was charged and reverse passes made over *language*, could give the music, but no words, and forgot even her own name; but when language was charged and tune demagnetized, she remembered the words but not the tune; when *eventuality* was demagnetized she forgot all events, even her own age.

* A breathing which resembles blowing, is electrical and calming in its nature while a gradual emission of breath near a person is warming.

VIII. The Organ of this Higher Vision.

1. That odic and psychic colors and objects may be seen by some other faculty than the outward eye must by this time be sufficiently established for most reasonable persons, and this must be accomplished by means of a different grade of light from that which illumines the external universe. If the following idea is sufficiently remembered it will save a great deal of trouble and many mistakes:—*No grade of vision can ever be accomplished without an eye to see with, or without light adapted to this eye.* We have seen in Chapter First, III, that the unity of law is everywhere so complete that we are safe in judging of the unknown by the known, and hence our rule. But nearly all persons treating of this superior vision have been misled in this matter, and the fact that so many scientific minds have wandered off wide from all fundamental law, led me to try to ascertain, in the beginning of this work, what are the great basic principles that rule immutably in nature. Writers will constantly affirm that the well known Seeress of Prevorst could see with the pit of her stomach, and Dr. Gregory, of Edinburgh, says that "Clairvoyants sometimes see with the epigastrium, top of head, occiput, fingers and even toes." That these great luminous centers where the nerves are so abundant, act as windows for admitting this finer light and conducting it to the inner vision at the brain, is no doubt true, but it would be a most useless thing and a vast waste of material to have eyes with their almost countless parts all over the body where more necessary organs are required. Suppose I view the moon through a telescope 20 feet long; the act of vision does not occur at the end which receives the light, but 20 feet away from it where my eyes are.

2. But what is the location of these interior eyes? And if a man possesses a finer interior eye he must naturally possess interior ears and all other parts of the body. Is not this the logical sequence of this admission? Have we not seen that there is a grander universe within the universe, and has not St. Paul spoken of "a natural body" and "a spiritual body?" And have not many persons been conscious of a second self which at times could look down upon their outward body?

Varley, the eminent English Electrician, once did this, and the doctrine of "the *double*," so well known in Germany under the name of "*Döppelgangers*" argues in this direction. In my own experience I have met several who at times have been able to look upon their own bodies which were lying near them, and occasionally have found difficulty in re-entering them. These would be connected by shining life-cords with their own bodies, and sometimes would see the indescribable radiance of the inner world. Dr. Cleaveland, of Providence, in the translation of Deleuze, speaks of a carpenter who fell from the staging of a building to the ground. "As I struck the ground," said he, "I suddenly bounded up, seeming to have a new body, and to be standing among the spectators, looking at my old one. I saw them trying to bring it to. I made several fruitless efforts to re-enter my body, and finally succeeded." (p. 367.) Is not this a most cheering thought, giving tokens of the immortal life and of a more beautiful existence to those who have become innately beautiful? Our outward flesh easily becomes corrupt or worm-eaten, and at death is disintegrated. But this inner body is finer than light itself or any known ethers, and having no elements of decay in it must continue to live. The materialist says that thought and mentality are absolutely impossible without a physical brain to think with. Well, I am not denying their proposition. Here is not only a brain but a whole body which are material in their nature, although of a very refined materiality, but still back of these must be the animating spirit itself. So that we have this finer eye about at the same point as the outer eye, only perhaps a little farther within, and the same with the other organs. This will account for the fact tnat so many persons who have had a leg or arm amputated will still continue to feel pains at times in the toes or fingers whose coarser counterpart is absent.

3. H. Helmholtz, Professor of Physics in the University of Berlin, and one of the eminent names of Europe, is an illustration of how weak in philosophy a man may sometimes be who is very skillful in science. He uses the following language in a lecture delivered at Frankfort and Heidelberg:—"We know that no kind of action upon any part of the body except

the eye, and the nerve which belongs to it, can ever produce the sensation of light. The stories of somnambulists, which are the only arguments that can be adduced against this belief, we may be allowed to disbelieve." Certainly! The learned Professor may be allowed to disbelieve in the existence of the Rhine, or any other immutable fact of nature, if he choose; but as long as this river will continue to exist and roll on towards the sea, it would be unwise to do so. Should he attempt to walk across its channel under the impression that no water exists there, he might fall into great danger, just as he does when he ignores these subtile forces of life which have such a bearing on all science. He then proceeds as follows, which shows that he has already got into a very dangerous pathway of thought: "But on the other hand, it is not light alone which can produce the sensation of light upon the eye, but also any other power which can excite the optic nerve. If the weakest electrical currents are passed through the eye they produce flashes of light. A blow, or even a slight pressure made upon the side of the eye-ball with the finger makes an impression of light in a dark room, and under favorable circumstances this may become intense. * * * Under these circumstances, at least, there is not the smallest spark of actual light." If Professor Helmholtz had properly studied the work of Reichenbach, written in his own language, he would have seen that there are hundreds of cases given in which sentitives could see the odic light under the stimulus of electricity, friction, &c., with its flames, sparks, and smoke as an actual entity, as real as the light of the sun. The fact that many persons can be stimulated to see these lights and colors by having their eyes electrized or pressed, should not lead him to banish all perception of light from the earth in its objective phases, as we shall soon see that he does, but should make him understand that there is more light than he at first thought there was, for similar effects must have similar causes. He then goes on to say that the "most complete difference offered by our several sensations, that, namely, between those of sight, of hearing, of taste, of smell, and of touch, *does not, as we now see, at all depend on the nature of the external object, but solely upon the central connections of the nerves which are*

affected. * * * These elementary sensations of color, can only be called forth by artificial preparation of the organ, so that, in fact, they only exist as *subjective phenomena.*" The Italics are mine. If all these sensations "do not at all depend on the nature of the external object," then a rose or a piece of carrion are alike to the sense of smell, pepper and sugar to the sense of taste, or the red and blue colors to the sense of vision. If the Professor had studied these fine laws of force, he might have ascertained the very laws of chemical affinity between the red light, for instance, and the nerve fibres which receive it in the process of sensation, and the entirely different chemical process between the blue light and the nerve fibres which receive it, and so with the other colors, which process will be treated of in the next chapter. He would see very clearly, too, that action and reaction being equal, the object acting upon the nerves of the retina, has exactly the same importance with reference to these nerves that the nerves have with reference to the object; or, in other words, the nerves of sensation depend as much upon the nature of the object as the object does upon the nerves of sensation. His theory makes the sensation everything, the object nothing, and tends directly into that system of idealism which pretty much annihilates the outward universe and sets up human consciousness as the all-embracing thing. But we ascertain at once how he has been misled when he affirms that his opinions "are clearly expressed in the writings of Locke and Herbart, and they are completely in accordance with Kant's philosophy." It is high time that these mere speculative systems of philosophy were laid on the shelf, and a system founded on nature substituted in their place, so that science shall no longer be kept in the back-ground. For other opinions on these matters, see Chapter Second. I will simply add that had I followed such principles I could never have discovered any laws of atomic action, of the chemical affinity of colors, or their therapeutical or other potencies, or a multitude of other things, for if I had believed that force or the perception of force "does not depend at all upon the nature of external objects," but rather upon something merely in the mind, I should have looked upon only one side of matters, and this is the best way to learn neither side correctly. Many of our scientific men,

however, including Helmholtz himself, are superior in practice to their theories, and so in spite of all deficiencies the world owes many great achievements to their discoveries.

4. I must be pardoned for telling a little story at the expense of these idealistic scientists :—

Alphonso, a young man who was fond of philosophy, became quite enamored of a certain silver-tongued reasoner by the name of Sophistes.

"My boy," said the would-be sage as they met for conversation, "there is nothing but the immortal mind, nothing but the conscious *ego* in the whole universe that has any real or absolute existence. Look at yonder sky. It appears to be a dome of blue sapphire, but go up into it, by means of a balloon, and the blue can never be found ; it is all delusion. In your childhood you were sure the rainbow rested on a distant hill, but when you chased it the whole thing turned out to be deception.* You say that yonder rep cushion is green. That is entirely owing to what kind of light touches it, for look, as I throw the light through a prism, and see how one part becomes red, another yellow, another violet, etc. Where, now, is your green ? † My friend, the color is 'all in your eye.' If color is anything at all why cannot we photograph it ? " ‡

* A similar style of sophistry was perpetrated by Dr. Geo. M. Beard in a lecture before a body of physicians in New York, in such language as the following :— "So far as the senses are concerned they deceive all of us every hour and every moment. * * * The sight is on the whole the best of the senses, but in civilized lands only fools trust it. If any man wishes to blunder, let him open his eye and believe what he thinks he sees." That is the way a man reasons who has a theory to prove, namely, that we should not reason inductively from facts ascertained through the senses. The truth is that not once in a million times will a person be deceived in reaching out the hand or foot to touch an object, but he will find it just where it seems to be. Animals are often still more acute in their perception, and thus vision is next thing to perfection in its accuracy, except when the eye is imperfect or diseased.

† This absurd argument has been advanced by eminent writers, but instead of showing that light is a nonentity, it proves with especial force that it must be a real substance that can thus rest upon and conceal the color beneath it.

‡ One reason, doubtless, why artists have not yet succeeded in photographing the chromatic colors in connection with their pictures, is because of the dynamic theory of force which, if true, would show the folly of attempting to photograph a nihility. Building on this theory, a New York paper has declared that color, not being a substance, cannot, of course, be photographed, hence the uselessness of trying. But we have seen in Chapter Fifth that it is a substance, and has been photographed imperfectly already.

"But," interrupted Alphonso, "are not metals, woods, liquids, etc., actual substances?"

"Put a powerful heat upon gold, silver, and platinum even, and they can be vaporized and passed away from your vision forever."

"And still their parts must continue in some form."

"Do you not see that if these hard elements can be thus dissipated and made invisible, it is quite easy to suppose that if a heat sufficiently great were brought to bear upon them they might be entirely annihilated? Reasoning from analogy with these other so-called objects which I have just spoken of, it must be so, and in reality they are shadowy nothings. As colors, then, and solids and liquids have thus no fundamental basis of substance, the same is true of sounds, and odors, and heat, and cold, and everything in the realms of being. Intellect and sensation and consciousness are the only entities and potencies which a philosopher can recognize. Does not Locke say that 'what in our sensation is heat, in the object is nothing but motion?' Does not Count Rumford also prove that there is no such thing as caloric, heat being a mere motion? Let us be keen enough, then, to rise above these phantasies and delusions around us, and dwell on the eternal rock of being within."

These and many other points were inculcated upon the young student, and he, becoming spell-bound by the teachings of Sophistes, was impressed with the grandeur of being a philosopher and the folly of heeding the material conditions around him to such an extent that he concluded not to take any more food or drink. "Such things," he said, "would do for ordinary stupid mortals who know no better, but so long as he knew them to be mere shadowy nothings, what folly to pay attention to them." His motto was, "Be strong in immortal thoughts and control all surrounding conditions by the might of volition." Reasoning thus, he became weaker and paler every day, and when his distressed friends entreated him to eat he proved to them their short-sightedness and said that when he had brought his mind into harmony with surrounding motions and conditions he should be all right. He, however, continued to waste away, when a friend, by the appropriate name of Llewellyn, which interpreted means *lightning*, determined to break the spell that was destroying him. He made an arrangement to accompany Alphonso to see his

mentor Sophistes, whom the young man had pronounced one of the greatest of philosophers, quite able, as he felt sure, to wind up Llewellyn in five minutes. "We shall see who will get the best of the argument," said the strong man who, by name and nature, was charged with a good stock of the principle of lightning.

Having reached the room of the wonderful teacher, Llewellyn remarked to him that his young friend here had spoken of his remarkable wisdom, and that he was anxious to hear his explanation of that which we usually suppose to be matter. Sophistes felt flattered, and went on in his most eloquent style to demolish the whole external universe, leaving not a vestige of it behind. Alphonso was pleased to see the wrapt attention with which Llewellyn seemed to swallow every word, and chuckled at the thought that he was already conquered. As Sophistes was about finishing up his glowing exposition, a terrific explosion took place, seemingly under his chair, which made him spring out upon the floor in great alarm, with staring eyes and a flushed face, declaring that somebody was trying to blow him up with a bomb-shell. Alphonso, too, being in a weak state, was very much frightened and rushed for the door. Llewellyn spoke up and said: "Friends be calm! I beg of you be calm! I defy any bomb-shells to hurt me! Have you not just proved irresistibly that sound is a nonentity, and heat a nonentity, or at most a mere motion, and that the thing which just exploded is really no thing at all? Why, then, this alarm? You surely believe your own theories?"

"Of course I do," said Sophistes, "but that was motion, a terrible motion, my dear Sir! Can't you understand me?"

"Certainly," replied the man of lightning, "and have been charmed by your beautiful language, but you see I am not in the least afraid of any motion so long as there is nothing to move. You have shown me very eloquently that what people call solids, liquids and gases are really mere moonshine, mere diluted nihilities, so of course the infernal arrangement that somebody placed under your chair could not hurt anybody, for there was nothing of it."

Sophistes tried to stutter out an argument and seemed quite excited, when Llewellyn exclaimed: Please be seated, my dear

sir, and I will show you by a practical illustration what a boundless faith I have in your philosophy. Have you a piece of gold coin, Sir?"

Sophistes handed over a half eagle.

"Have you also a handkerchief with you?"

Sophistes passed a neat white handkerchief to him.

Holding them up, Llewellyn exclaimed: "Very pretty indeed! I once thought they were real substances, but now I find out otherwise. What dreamers we all are, living in a vain delusion! I don't wonder you look with pity upon the great vulgar crowd who are ever clinging to the shadowy nothings around them as if they were something genuine. I used to think that heat was a severe reality, but now I find it is a mere matter of sensation, a subjective matter, being nothing but motion in the object. Now if I should throw this handkerchief into that fire, it would not give you any sensation of heat, and therefore there would be only some motion going on in the handkerchief, which, of course, would not amount to anything. To prove it, I will try it and see," at which the lightning man had the handkerchief in the fire in a twinkling. Its owner sprang forward with a groan and clasped the burning article, but not before some ugly holes had been made in it. His face was as red as fire as he exclaimed:

"Sir! are you crazy?"

"Well," said Llewellyn with a puzzled look, "either I must be crazy, or you must be, for there is a powerful objective something somewhere, else how could those holes have come? I think I had better not make any more experiments, as I have had bad luck, and so I believe I will go home." Saying this he started off and beckoned to Alphonso to follow him.

"But stay!" said Sophistes, "I will take that five dollar gold piece if you please."

"Excuse me," said the man of lightning, "you have proved conclusively that gold and other solids are mere diluted moonshine, or in other words simply nothing at all. Since you know this to be the fact, and since my last experiment has shown me that there may be a reality in these objects, I will just take this piece along with me and see how it turns out."

"Saying this he started out into the street followed by Sophistes, who cried "Police! Police." A policeman immedi-

ately made his appearance. The reader, I presume, will perceive that Llewellyn had prearranged all matters, including the explosive, as well as the policeman who had been informed of the programme.

"Explain this conduct, sir," said the policeman to Llewellyn, with some show of sternness.

"Certainly. This is the explanation:—This gentleman is a *philosopher*," emphasizing the word philosopher—"and he has proved to me very powerfully that gold and other substances have no real existence as distinctive objects—that they are shadowy elements which may be dissipated, and consequently are mere nonentities. Now I am not quite sure of this fact, and so I wish to take it home and experiment a little upon it. As he is sure that there is nothing in it, he certainly should not feel that he is losing anything.

"If you don't consider that the gold is any special object," said the policeman to Sophistes, "why do you object to his taking it?"

Sophistes quibbled some and showed much excitement, and vowed that he would not be robbed by wrong applications of his principle.

By this time Alphonso, who had been silent so long, became so indignant that he could hold in no longer. Rushing up to the sophist, he exclaimed:—"Sir, your fine words turn out to be nonsense when put into practice. The truth is you and I are both fools, you a dishonest one from not acting up to your own theories, and I an honest one who have already starved myself nearly to death as a proof of my sincerity. I shall hurry off and get something to eat, for I feel now as though a good beef steak would weigh down a hundred of your arguments."

He was hurrying off, when Llewellyn caught him and bade him wait a moment, as it was necessary for him to attend him and prevent his over-eating. Turning to Sophistes, Llewellyn exclaimed:—

"Sir, my purpose has been accomplished. I shall trifle no more with this subject; I came here to show this young man that a few simple facts would scatter your theories to the winds. So far as my methods have seemed rude, I beg your pardon, and my excuse is that when men wall themselves about with very absurd

channels of reasoning, they can only be liberated from it by some rather hot and explosive styles of facts. I have not had the most distant idea of wronging you, and now offer you the gold, which is one of nature's eternal entities, and a dollar more to pay for the handkerchief destroyed. Let me beg you not to further mislead people's minds by attempting to destroy the whole outward universe, especially so long as you cannot prove that the most minute particle of matter has ever been or ever can be destroyed."

These words were hardly finished before the indignant sophistical philosopher had withdrawn into the house and slammed the door.

5. Does my reader say that the foregoing is an extreme view of things, and that such a philosophy has not been held by any one? Is it not the logical sequence of even the reasoning of Helmholtz, and especially of Kant and others whom he follows? To show that the mystic schools of Germany go even beyond what I have represented, I will quote a little from Dr. J. R. Buchanan :—" Kant, in opposition to the cosmologists, denied our ability to know anything of the world, or of being exterior to ourselves, because of the limitation of our faculties. He affirms that space and time are mere conditions of *our own perceptive faculties*, and that if we would understand external objects we must conceive them independent of space and time; and, as we cannot do this, we cannot know anything truly, but can recognize certain delusive appearances. * * * Fichte, equally absurd with Kant, decided, by a course of inconsequential reasoning not worth repeating in its jejune tediousness, that *man exists*, but *nothing else*. The supposed reality beyond man (the universe and Deity), is merely derivative from man; in other words, is merely an affection of our consciousness. Of course, then, each human being must consider himself the universe, and all other human beings being an effect of his consciousness, as he is but an effection of their consciousness—which seems logically to annihilate the substantial existence of man, leaving only ideas. It was with reference to such a philosophy that a Boston transcendentalist was said to have pronounced it very unphilosophical to say, 'It snows,' or 'It rains.' It would be more philosophical to say, 'I snow,' or 'I rain.' * * * The next step in misological absurdity is to deny, with Kant, the existence of time and

space, affirming that they appertain only to our minds. The next beyond Kant is to deny all perception, with Fichte and Schelling, and affirm that nothing exists but our own consciousness or thought. The very *ultima thule* of absurdity is reached with Hegel in ignoring our positive consciousness of self and observation, to affirm a limitless consciousness—unlocated, undefined, and commingled with being and unconsciousness, in a *tertium quid* which defies description or even conception." (Brittan's Quarterly, July, 1873.)

XIX. The Medical World.

1. *The lack of knowledge of these Fine Forces* is constantly apparent in the medical profession. When they wish to get up an action in certain parts of the system, they know of no better way than to produce new diseases in those parts, by blistering, burning with hot irons, leeching, lancing, drugging, using setons, etc. If they would keep up with the progress of the day they would ascertain that counter irritation and counter diseases are generally unphilosophical, as passes and friction from a warm magnetic hand can draw the blood powerfully to any desired part of the body, or call it away from any part, and that in a way to cause no local harm but to animate the whole system. They should learn also that by means of sunlight, aided by lenses, as well as by electricity and water, they may in many cases produce the same result, and that without any severe after effects. More than this they would see that the barbarous practice of *transfusing blood* from a living human being or animal into the veins of a patient, is far less scientific than the transfusion of psycho-magnetism and vital magnetism through the whole nervous system, and thence through the whole vascular system, by means of which a pure and fine flow of blood can be developed on natural principles, and the life forces made strong from the very foundation. If you tell them about this higher science of life, these diviner essences of power, they cannot see them or clasp them in the hand as they can drugs or lancets, and so very many of them will pronounce such methods "*quackery*" or "*fanaticism.*" They however seem to be so afraid of the rising power of these "quacks," and are so anxious to protect the interests of *the people,* which

expression being interpreted means the *medical people*, that they will sometimes raise heaven and earth to have laws enacted against allowing them to practice until they have passed through the same false systems of collegiate medical training as themselves. These quacks cure thousands of cases that baffle the power of drugs and surgery, and I could fill large volumes with their achievements which would be considered almost too remarkable to be credited. I am no advocate of ignorance and would glory in a true system of medical education founded on nature's higher methods, but *an ignorant healer who deals with the fine forces will in most cases do more good and less harm, than a so-called learned physician who practices only with the coarser elements.* I will quote a very few of the admissions of eminent physicians themselves, as the best proof that the cruder elements of nature are not suited to build up so refined a being as man, and also to show that those who build so much upon such forces, are quite conscious of their failure in arriving at the true elements of power, or in attaining to a scientific basis of cure :—

"Our remedies are unreliable." *Valentine Mott, M.D.*

"Of all sciences, medicine is the most uncertain." *Dr. Willard Parker.*

"I have no faith whatever in our medicines." *Dr. Bailey.*

"Medicine is so far from being a science that it is only conjecture." *Dr. Evans.*

"Mercury has made more cripples than all wars combined." *Dr. McClintock.*

"So gross is our ignorance of the physiological character of disease that it would be better to do nothing." *Dr. Magendie.*

"Digitalis has hurried thousands to the grave." *Dr. Hosack.*

"Blisters nearly always produce death when applied to children." *Prof. C. R. Gilman, M.D.*

"Drugs do not cure disease ; disease is always cured by the *vis medicatrix naturæ*." *Prof. J. M. Smith, M.D.*

"Opium diminishes the nerve force." *Dr. Davis.*

"The older physicians grow, the more skeptical they become to the virtues of medicine." *Dr. Stevens.*

"The action of remedies is a subject entirely beyond our comprehension." *Prof. John B. Beck, M.D.*

"I fearlessly assert, that in most cases the patient would be safer without a physician than with one." *Prof. Ramage, M.D., F.R.S.*

"Let us no longer wonder at the lamentable want of success which attends our practice, when there is scarcely a sound physiological principle among us." *Dr. Magendie.*

"The science of medicine is a barbarous jargon, and the effects of our medicines on the human system are in the highest degree uncertain, except that they have already destroyed more lives than war, famine and pestilence combined." *Dr. John Mason Good.*

The uncertainty and failure signified by the above expressions of high toned and honest physicians must ever continue until men shall learn the dual relations of matter and force, the law of atoms and ethers, and through them the principles of chemical action as applied not only to the coarser elements of external nature, but to the finer physiological and psychological phenomena of man. I do not protest against medical science, but against the lack of science, and against that arbitrary spirit among the lower ranks of our medical men which would make laws to fine and imprison all who practice on a plan different from their own, although their own is admittedly very imperfect, while the men whom they would enchain might prove to be the Galileos and Harveys of a new and grander medical dispensation which shall yet give joy and power to the world. The intelligent people of Massachusetts have triumphantly defeated the attempt to enact these despotic laws which would crush out the freedom of the people to choose their own medical advisers. On the same principle they should make laws to determine what clergymen, what teachers, what merchants should be employed, what churches should be considered safe to attend and what style of schools should be allowed, and having thus put the people in swaddling clothes as being incapable of self-government, should appoint guardians over every family to tell them what they may graciously be allowed to eat, drink, or wear. The laws of Illinois and California on this subject, are a disgrace to those States, and even those of Ohio, New York, and some other States, though of a milder type, show that their people have not been sufficiently acute in their perceptions, or manly in their love of liberty, to prevent their legislators and designing physicians from getting the advantage of them. In making these remarks I am not condemning all physicians by any means, for very many of them are grand men who rise above their schools, seeking for truth in all directions, and following nature's diviner teachings. Such ones have no hand in persecuting others.

2. *The Drinking of the Blood of Animals*, newly butchered, is a disgusting practice which also arises from ignorance of these finer forces. In New York, and perhaps other cities,

many refined ladies and gentlemen are in the habit of going daily to places where cattle are butchered, and imbibing glasses of freshly drawn blood. This in some cases is found to be beneficial, but why, they cannot tell. The truth is that when the blood is first drawn, before the subtle magnetic life fluids escape, there is an animating principle in it which may strengthen and vitalize to some extent. This vital element is what keeps the blood fluidic and active, and when it escapes the blood stiffens into clot. The folly of these *blood-thirsty* persons consists in the fact of their not knowing that they could get a far more refined and potent life power from the touch of many human beings, some of whom can rival the galvanic battery in immediate effect and far outdo it in the fineness and durability of their power. This power of psycho-electricity was well tested by Prof. S. B. Brittan, in Saratoga, before an audience of several hundred persons some years since. A Mr. Cook who, from his knowledge of electrical science, had been employed by the government, denied that there was any such thing as vital electricity, and stated that he could knock a man down with his electrical apparatus; and when Prof. Brittan "would do the same with his mental electric battery he would believe that electricity had something to do with the phenomena in question." Two worthy young men, strangers to Dr. Brittan, were chosen by the audience and sent upon the platform. After manipulating them a little he directed them to stand firmly, 12 or 15 feet distant from him. He then made a powerful effort of the will and forward thrust of his hands towards them which struck them to the floor as though they had been shot. Mr. Cook immediately left the audience without saying a word, which was a confession of defeat. Some account of this may be found in Brittan's "Man and his Relations," p. 40.

3. While *disease*, according to the old schoolmen, has generally been treated as originating and developing in material conditions, according to Hahnemann and the modern idealists, it has its origin wholly in spiritual conditions. While the latter have done great good by refining the conceptions of the people, my readers by this time have seen an overwhelming array of facts to show how matter and spirit must work forever in

correlation, while the attempt to build on matter alone, or spirit alone, is like driving a carriage with one wheel.

XX. Miscellaneous Points.

1. *The Universal Unity of Things* is apparent from the whole tenor of this work, all things in their basic principles resembling all other things, so that we may judge the whole by a part, the unknown by the known, and the invisible by the visible. We have seen that one great difference in the methods by which this unity manifests itself is, that there is an infinite stairway of degrees reaching from the coarse to the fine, progressing from solids to semi-solids, to liquids, to gases, to ethers, and, finally, to that inconceivable fineness, and subtlety of principle which we term *spirit*. Thus we have the spiritual and material ever blending, ubiquitous, eternal and necessarily correlated in all things as the positive and negative principles of force, or as the basis of all action and reaction. We have seen how the material and spiritual are simply the two ends of the same immeasurable scale of being and both subject to the same laws of chemical action. Does my reader say that the spirit can *think* and *perceive*, while the material or bodily portion of man cannot? This is a great error which should be laid on the shelf as soon as possible, as I have already shown perhaps a score of times, that all possible action must have its dual relations, spirit not being able to act without connection with some grade of matter as a reactive element, nor matter without being potentialized by spirit. Seeing, then, that there is such an absolute unity and interblending and correlation throughout the universe, it is evident that Herbert Spencer is mistaken in declaring that there is a realm of the "unknowable," and many philosophers of the day are mistaken in asserting that we can gain no possible conception of infinity. While we can gain no proper conception of the vastness of the infinite whole, yet, building on the foregoing principle, we may gain a clear conception of the constitution of the infinite, for if we take the smallest atom and mount from that up to a drop of water, which is a huge globe in comparison, and then expand

our view until we take in a world, a solar system, a cluster of solar systems, or in fact the whole known universe, we find not a particle of difference in their great fundamental principles, such as unity, diversity, gradation, contrast, etc. So far, then, we may be said to grasp infinity itself, and *qualitatively* considered there is no absolutely unknowable realm, however short we may come in the *quantitative* grasp of things.

2. *The Magnetic Needle.* Having this conception of the fraternity of all things, the philosophy of much that is now obscure becomes comparatively simple. Suppose we ask why it is that the magnetic needle points to the north magnetic pole? We know that a vane is swept around in a certain direction by currents of air, and a stick of wood, by currents of water, and that all known displays of force are caused by a current-like or wave-like flow of some fluid, and so we may be sure that certain currents or ethereal winds of force drive the needle around in their own direction. In Chapter Fourth we have seen just how and why certain magneto ethers are drawn northward on the law of thermo-electricity, and thus made to turn the needle northward, and how certain magnetic curves or whirlwinds of force, sweeping into the earth, deflect the needle downward in what is called the *magnetic dip.*

3. *Mental Action.* How does mind control matter? Let us again come right to nature's simple method of operating. We have seen that no mental action can take place until the convolutions of the brain have been awakened into life by the sweep of fine ethers as well as blood through them just as in a landscape a tempest brings all surrounding objects into action. But volition and mental action of various kinds can send the ethers and with them the blood to various parts of the body; can make the maiden's cheek blush; can send these life currents to the heart and cause paleness under an impulse of fear; can send electric currents to contract muscles, and thermal currents to expand them, and bring about a hundred other kinds of effect. Many persons, including the author, have learned to will the vital electricities to the hands or other parts of the body with a power that causes them to thrill and burn. A magnetic physician once informed me that he had treated a tumor on one of his limbs for months without any special effect, until finally he concluded to

fasten his will upon it while treating it, when to his surprise it immediately commenced going down and soon became entirely well. How does spirit accomplish such a movement among physical conditions? Exactly on the same principle that the body can do the same. If a human hand can dash water into eddies or currents in any direction it pleases, so can the human spirit dash those spiritual and psychic ethers with more than lightning speed in whatever direction it pleases, and through them waken the animal ethers and nerves and blood and muscles and the marvelous forces of the brain itself. If a physical hand is moved, this motion requires the play of certain chemical and galvanic action. Does not the spirit also have its marvelously fine play of chemical forces? Have we not seen from the color radiations of the brain and body, that all mental as well as physiological action involves exquisite grades of chemical affinity and chemical repulsion? Seeing, then, that these fine forces, guided by this simple generalization, can thus open up the pathway of divine wisdom and reveal so many secret hiding places of power, why shall men stupidly shut their eyes and ears to them, and groveling among the grosser conditions of matter, declare that nothing can be known of the basic principles of molecular, or chemical, or physiological, or psychological action?

4. *Memory.* How can the mind bring up and retain *images* of past or distant events in the way which constitutes *memory?* Just as a photographic plate can receive and retain images of objects which are thrown upon it. The photographic image is formed by sunlight aided by proper chemicals. These mental images are formed by the higher grades of light, aided as we have seen by the interior chemical forces of the brain. Psychometrists and clairvoyants can, at times, so come into rapport with this finer light as to see these mental images and read the events of a lifetime to the astonishment of the persons thus read. Thoughts, imaginations and passions also stamp actual images on this wonderful tablet of the soul, which thus constitutes a book of life that at some future time may cause great mortification to the owner, unless the gross and selfish imaginations may be sufficiently covered up or erased by those of a nobler kind.

5. *Self-Psychology.* Dr. Fahnestock, following the lead of Dr. Braid, Dr. Carpenter, and many other physicians who, from

their mental constitution and bias, are unfitted to perceive or explain correctly the working of these fine psychological forces, contends that there is no such thing as any magnetic or fluidic emanation which may pass from one person to another, but that all mesmeric, somnambulic or similar phenomena are caused by *imagination,* or *suggestion,* or *volition,* or some other action of the *mind.* This is on a par with saying that Goliath was not smitten by a stone from David's sling, but by David himself. In other words it declares that the mind does something, but quite ignores the instrument through which it works. In my little work addressed to Dr. Brown-Séquard,* I supposed that I had given an array of facts which would entirely destroy any such hypothesis, as they showed the power of these forces to work at a distance upon adults and sometimes upon infants who were entirely unconscious of their exertion, but it makes no difference how often you kill these theories, they will come to life again the next day in some other form. The method by which the doctor beclouds his own and other people's vision at present is, by asserting that a person may put himself into the mesmeric or statuvolic condition, and therefore this is conclusive proof that he never receives any emanations from another person. By similar reasoning we may say that a man can dash water upon himself, therefore no one else can dash water upon him. I have already shown that the mesmeric or lucid sleep consists not only in having the vital ethers and blood of the brain drawn away into the body by means of passes from some other person's hand, or sent away by one's own volition, but in drawing outward the finer and more powerful psychic ethers by means of looking at some object, or thinking of some object, outside of one's own brain. A person who is finely magnetic can assist in charging another's brain and putting it in rapport with these fine forces, a man like Major Buckley, whom Dr. Gregory describes, being able to charge people so powerfully that multitudes became clairvoyant, while other persons would impede clairvoyance. Many persons, however, can learn to control their own forces without the aid of others at the time.

* Vital Magnetism, the Life Fountain ; being an answer to Dr. Brown-Séquard's Lectures on Nerve Force; the Magnetic Theory defended and a better Philosophy of Cure explained, by E. D. Babbitt, D.M. Price, postpaid, 25 cents. Babbitt & Co., 141 Eighth St., N. Y.

6. *The Stupidity of Investigators* of these fine forces may be seen in the case of a number of positive skeptical persons as they get around a sensitive subject, and perhaps taking him by the hand will laugh and jest and show their incredulity as they require him to see through solid matter. Sometimes they will practice deception upon him, for a sensitive is generally in so negative a condition that he can easily be psychologized to believe and admit almost anything that a positive mind may desire, and so when they sometimes succeed in making him admit a falsehood, they chuckle over the matter and declare that *imagination* or *suggestion* is all there is of it. Instead of exulting thus in their own supposed shrewdness, they should mourn over their supreme folly, and ignorance of law, and the wrong they do to a divine cause. The author, in most cases, cannot see clearly with this inner vision if a single person is in the room, and while charged with these lightning ethers sufficiently to see the glorious colors and lights of the interior world, the tension of his system will be so great and his sensibility so keen that a sound like the dropping of a pin will sometimes make him start and will completely dissipate all colors and forms. I have seen a lady while in this sensitive condition, thrown into spasms by the falling of a small article of furniture, and very few sensitives in the world can exhibit their powers before a noisy audience with any success. Investigators should have a supreme love of truth and should be able to remain entirely passive at such times.

XXI. Summation of Points in Chromo-Mentalism.

1. *Intellect is the culmination of power, and may be affected indirectly by ordinary light, still more by odic light, and most of all by the psychic light which is the direct messenger and servant of the spirit in its relations to the outward world.*

2. *The psychic lights and colors are inexpressibly beautiful and manifest the infinite activities of nature unseen by ordinary eyes.*

3. *This higher vision exalts the conception and shows that there is a grander universe within the visible which is the real cosmos.*

4. *Thousands of persons are able to see these psychic colors.*

5. *They reveal the primary laws of force. When scientists dwell only*

among the coarser grades of matter, they deal with the outer shell of things, and fail to find the richer kernel within.

6. *This light renders opaque substances transparent from its power to penetrate them, and hence those who can get in rapport with it become what is called clairvoyant. The Committee of the French Royal Academy recognized this fact, and Major Buckley developed 148 persons so that they could read sentences shut up in boxes or nuts.*

7. *Ordinary sleep is caused by drawing the vital ethers, and with them the blood away from the front brain into the cerebellum and body, thus leaving the mental powers so inactive as to be unconscious, while somniscience, or the lucid magnetic sleep not only calls these coarser vital ethers away, but brings into action the finer interior forces which being more swift and penetrating cause greater keenness of mental power, and, when sufficiently developed, clairvoyance itself.*

8. *This lucid condition is often induced by fastening the mind on some near or distant object to draw the finer ethers outward, and is sometimes assisted by downward passes to draw the coarser ethers away from the brain.*

9. *These psychic forces can bless mankind by opening up a sublimer vision of the possibilities of the universe and of human life, by controlling physical, mental, and moral diseases in a very remarkable way, and by circumventing fraud.*

10. *Self-Psychology, or Statuvolence, is a condition which is brought about by getting in rapport with these psychic forces, when by the power of the will the subject can cause all sensation to cease in a part or the whole of his body, or cure disease, or permanently correct many of his mental and moral deficiencies.*

11. *Every part of the intellectual, moral, or passional nature can be aroused into greater action, or subdued into a feebler action by charging different portions of the brain and body with these psychic forces with the hand, or otherwise, or by drawing them off. When the subject is in a somnambulic or otherwise sensitive condition, each part of the brain so touched will arouse a special and intense kind of thoughts and feelings entirely different from every other part, thus showing that the brain has its special organs, or regions of special mental characteristics. The psychic colors which vary in different parts of the brain in harmony with these organs, also confirm the same idea.*

12. *The fine forces of the brain radiate colors on much the same principle as the odic forces in nature.*

13. *The left hemisphere of the brain receives the blue and electrical forces and radiates the warm red forces more strongly than the right, while the right brain radiates the blue forces and receives the red more strongly than the left. The left brain is stronger in the domain of intellect; the right, in that of organic life.*

14. *The highest faculties radiate their forces most strongly upward; the lowest, most strongly downward. The Intellectual faculties radiate their forces both upward and downward in front, the Propelling faculties, both upward and downward behind, and the color radiations are beautiful and pure about every person in proportion as his mental and moral character becomes refined and ennobled.*

15. *Intuition is large in proportion as the psychic forces gain activity in a person, and small in persons whose brains use mainly the ordinary slower ethers. Geniuses, and prodigies of swiftness in mental action, abound in these finer ethers. Woman is more intuitive than man on the average, and being more subject to influx ethers is more sympathetic. Systems strong in the psychic element are especially elastic and recuperative in their vitality.*

16. *The poles of bodily organs, so far as examined, radiate colors which form a chemical affinity with those of the brain, hence the attraction between them.*

17. *The brain has been seen to have five great leading poles, or centers of luminous radiation, the greater of which is in the center, besides which it has minor poles in all the organs, which connect with the central pole. Besides these all of the ganglia and organs of the body have each one or more poles. All sensations and perceptions cause luminous streams of force to pass to the great central pole of the brain from which they are reflected to the external gray matter that constitutes the organs of thought and feeling.*

18. *The reddish gray matter of the brain and nerves, and the bluish white matter of the same, constitute those elements of chemical affinity without which the psychic ethers could not act, and hence all sensation must cease.*

19. *The motor nerves are strong in the intellectual, and the sensory nerves in the passional and emotional portions of the brain.*

20. *A human being must have special organs for special operations of the mind as truly as for walking, seeing, hearing, etc.*

21. *No vision can ever take place without an eye, or without a grade of light adapted to that eye, as Nature never works without instruments, and never violates in one department of being the general law which she follows in another. This finer vision then shows that we have a finer eye than the outward, to which this more exquisite light is adapted, and having eyes of this superior interior character we must have a whole body to match them, a fact that is abundantly proved by the revelations of this diviner light itself, which has often portrayed the human double.*

After giving all these facts and deductions, will not the reader indulge me in one little speculation? As we have this finer body within the coarser, and composed of materials which are never known to decay like gross matter, and which, as we have seen, must be vitalized by a spirit incomparably finer still, is it not reasonable to suppose that when it lays aside the outer garment at death, it must rise by its own gravity, in case it has been sufficiently refined by a true and pure life, into higher realms of space, some distance above the earth, where all things exist in a much more ethereal and exquisite condition? In Chapter Fourth, VII, we have seen that in the ever refining and radiating processes of nature, the more ethereal portions of all matter are being thrown off into space, that exquisite light and fine elements of oxygen, carbon, sodium, lime, silex, hydrogen, nitrogen and other elements of our earthly soil send their emanations upward into the atmosphere, and becoming still more ethereal must rise even higher than what we usually call our atmosphere, for all things must rise in proportion as they become light and airy. Now is it not reasonable to suppose, nay, must it not be almost a certainty, that the immense play of chemical forces through these upper realms, must have segregated and aggregated vast masses of these exquisite particles of earthly matter, until islands, continents, and perhaps almost a continuous belt-work of this divine Kingdom of the Father have been thus constituted? Reichenbach's sensitives ascertained how much more brilliant were the odic lights and colors when the atmosphere was removed, and we may imagine how superbly fascinating must be the psychic

grade of light where no gross elements intervene. Does it strike you that this celestial zone would interfere with the brightness of the sun's light on our earth? So far as it would affect it at all, it must increase this brilliance, for we have seen that we cannot get any effect of light except when the luminous ethers pass through chemically formed particles of matter which we call luminelles, and which float in our atmosphere. Thus we have our radiant celestia crystallized and developed on natural principles. But we have no heavenly realm yet until we can get landscapes, and flowers, and trees, and lakes. Can we get these on natural principles? Why not? We have simply a more exquisite soil, made up of the emanations of the earthly soil itself. If flowers and trees will grow from our coarser and more inert earthly soil, how much more rapidly should they grow from this very soil in its fine and more active conditions when transferred to these more powerful realms, and if the water of the earth is beautiful, how much more beautiful must its finer counterpart be in the higher lakes. Think you it would be too cold there for vegetation and human life? But the coarser grades of heat and cold which rule here, have no effect on the finer conditions. The fine thermal and electrical rays that radiate from everything would be just suited to the conditions there. The light of the sun, moon, and stars would not be visible in its present form. Only their subtler rays would be seen and felt. Thus at last, may we not have some conception of Heaven, how it has been formed, and what its materials, glorious conditions, and locations are? Locations, I say, because there must be portions far higher and finer than those I have been describing suited to conditions of advancement, for man must ever pass onward and upward towards the Infinite Perfection as eternity glides along. Is not this the realm that John of Patmos saw with his inner vision, a portion of whose sublime simplicity of language I will quote: "And I saw a new heaven and a new earth: for the first heaven and the first earth were passed away. And I John saw the holy city, now Jerusalem, coming down from God out of heaven. Having the glory of God: and her light was like unto a stone most precious, even like a jasper stone, clear as crystal, and the city was pure gold like unto clear glass, and the foundations of the wall of the

city were garnished with all manner of precious stones. And he showed me a pure river of the water of life, clear as crystal. And there shall be no night there; and they need no candle, neither light of the sun; for the Lord God giveth them light, and they shall reign for ever and ever." We have seen that around a low, or selfish or impure character, there are dark and heavy emanations, and until cleansed from such conditions, the spirit must be too gross to gravitate into the higher realms of being. I have ventured to speak of this celestial realm after which so many human hearts have aspired, and which so few have any conception of. And can this be called a mere speculation? Have I not built upon the known facts, analogies and laws of things? Did not the Brahminical sacred writer far back in the misty ages of the past get a glimpse of this land of beauty, when he exclaimed rapturously: "Where there is eternal light in the world, where the sun is placed in that immortal, imperishable world, place me, O Soma! Where life is free, in the third heaven of heavens, where the worlds are radiant, there make me immortal!" (*Rig Vedas, 1580 B.C.*)

Let us pause a moment and see how light is used in various ages to typify the Supreme Being, and the most exalted of all conceivable qualities and objects.

In the portion of the Hindoo sacred writings called the BHAGVAT GEETA, written according to Sir Wm. Jones 3000 years B.C., occurs the following sublime passage:—"The glory and amazing splendor of this mighty being, may be likened to the sun rising at once into the heavens, with a thousand times more than usual brightness. * * * Thou art the Supreme Being, incorruptible, worthy to be known! Thou art prime supporter of the universal orb! * * I see thee without beginning, without middle, without end; of valor infinite; of arms innumerable; the sun and moon thy eyes; thy mouth a flaming fire, and the whole world shining with thy reflected glory!" (*Charles Wilken's Translation.*)

"That All-pervading Spirit, which gives light to the visible sun, even the same in *kind* am I, though infinitely distant in degree." (*Rig Vedas.*)

"Zoroaster, whose period of life is variously estimated at from 560 to 1300 years B.C. calls God (Ormuzd) the "Self Luminous,"

"The King of Light," and says: "The soul is a bright fire, and by the power of the Father, remains immortal and is mistress of life."

"He is Life, Counsel and Light." (*Orpheus, B.C. 1200.*)

"There is One Universal Soul, diffused through all things, eternal, invisible, unchangeable; in essence like truth, in substance resembling light." (*Pythagoras, B.C. 586.*)

"God is Truth, and Light is his shadow." (*Plato, b. 429 B.C.*)

"They that be wise shall shine as the brightness of the firmament, and they that turn many to righteousness, as the stars, forever and ever." (*Daniel, B.C. 534.*)

"The sun shall be no more thy light by day; neither for brightness shall the moon give light unto thee: but the Lord shall be unto thee an everlasting light, and thy God thy glory." (*Isaiah, 698 B.C.*)

The following is from a celebrated poem on "Milton in his Blindness," written by Miss Elizabeth Lloyd, of Philadelphia. Its author seems to have come into rapport with this diviner illumination of the inner life just as every true poet does:

Oh! I seem to stand
Trembling where foot of mortal ne'er hath been,
Wrapped in the radiance from thy sinless land,
Which eye hath never seen.

Visions come and go;
Shapes of resplendent beauty round me throng;
From angel lips I seem to hear the flow
Of soft and holy song.

It is nothing, now
When heaven is opening on my sightless eyes,
When airs from Paradise refresh my brow,
The earth in darkness lies.

In a purer clime,
My being fills with rapture—waves of thought
Roll in upon my spirit—strains sublime
Break over me unsought.

Give me now my lyre!
I feel the stirrings of a gift divine;
Within my bosom glows unearthly fire
Lit by no skill of mine."

CHAPTER ELEVENTH.

VISION.

1. General Machinery of the Eye.

1. Before bidding adieu to my reader, I must give a brief account of the machinery of the eye, and the general processes by which the sensations of light and color are communicated to the mind. Vast volumes have been written upon the eye, and its conditions and diseases, but this work has already expanded beyond my intentions and I can give only a general outline of the subject, in which I shall aim to embody some useful hints and to clear up what I deem to be a radical misapprehension among scientists, with reference to the general philosophy of vision.

2. Some of the Leading Parts of the Eye may be seen in fig. 197, and are as follows: 1, the *cornea*, a hard transparent coat in front of the eye and reaching about one sixth of the circumference of the whole eye. It has been compared to a watch crystal, with each end merging into the sclerotic coat of the eye. 2, the *iris* or colored portion surrounded by the white of the eye. This has a hole in the middle called the *pupil*, through which light passes to the inner portion, and consists of a great number of radiating muscular fibres which contract and expand so as to make the pupil increase or diminish in size in proportion as the light becomes too feeble or too intense. 3, is the *aqueous humor* of the *anterior chamber*, back of each end of which is the *posterior chamber*, oc-

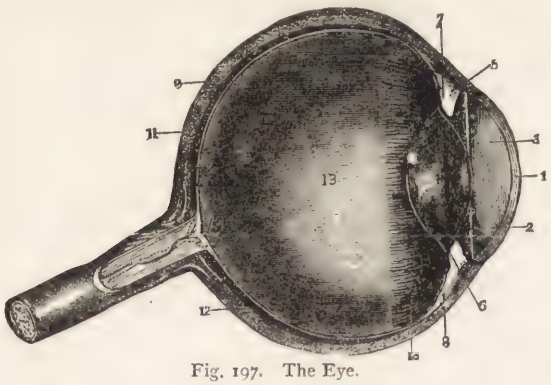


Fig. 197. The Eye.

cupying the triangular space. 4, the *Crystalline Lens* enclosed in its capsule, and being more convex on the posterior than on the anterior side. This beautiful lens is very elastic, and being more dense than the aqueous humor in front, or the vitreous humor behind, has greater refracting power than they, and performs an important office in helping to concentrate the rays of the external world to a focus on the retina; 5, is a circular sinus called the *Canal of Fontana;* 6, *Canal* of Pettit; 7, the *ciliary processes* are folds, 60 or 70 in number, of the front margin of the choroid coat and terminating externally in the iris; 8, the *ciliary muscle* is a circular band of unstriped fibres connecting the junction of the sclerotic and cornea with the choroid coat, and acting upon the ciliary processes and crystalline lens; 9, the retina, the most wonderful of all, is the innermost coat of the eye. It is the exquisite curtain, hung over the whole back of the eye and extending around the sides to the ciliary processes near the front, upon which the sunlight paints its pictures of the outward world, just as pictures are painted upon a photographic plate, the eye itself being often compared to a camera obscura. Its processes will be described hereafter; 10, the *ciliary zone*, or *zone of Zinn*, is a ring of folds radiating around the crystalline lens, and fitting into the ciliary processes; 11, the sclerotic or hard coat of the eye, commences where the bulge of the cornea ends, is seen a short distance as the *white of the eye*, and is perforated by the optic nerve behind. It has grooves for the ciliary nerves, and the muscles of the eye-ball are inserted into it; 12, the *choroid* coat forms a background for the retina, and being supplied with a black pigment there is no danger of a confused reflection of rays through the retina. The folds of the front margin of the choroid constitute the *ciliary processes* which form a circle around the edge of the crystalline lens behind the iris; 13, the *vitreous humor*, a clear jelly like substance, which forms about four-fifths of the whole eye-ball. It is enclosed by the *hyaloid* or *limiting membrane* of the retina; 14, is a depression of the retina, sometimes called the *yellow spot* of *Sœmmering*, or the *fovea centralis*, and is the point of most distinct vision. It will be described hereafter; 15, is sometimes called the *punctum cœcum*, or *blind spot* of the eye, being the entrance of the optic nerve. This nerve in each eye enters on the posterior part somewhat near the nose.

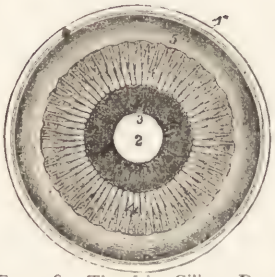


Fig. 198. The Iris, Ciliary Processes, etc.

3. Fig. 198 gives a transverse section of the front portion of the eye: 1, being the divided edge of the *sclerotic, choroid* and *retina;* 2, the *pupil;* 3 the *iris;* 4, the ciliary processes; and 5, the scolloped *border* of the *retina.*

4. The machinery of the eye is still better seen in fig. 199, in which a considerable of the harder sclerotic coat is cut away so as to show the more interior choroid with its veins sweeping around in such curves and whirls of form that they have been termed *vasa vorticosa.* This net work of veins, forming as they do a bed upon which lies the great system of nerve fibres in the retina, must be attended with a play of vital ethers which have an animating effect upon the retina itself. A small portion of the *ciliary muscle* is shown, together with some of the ciliary nerves which conduct the vital electricity to it, and by causing it to contract, influence the shape of the crystalline lens itself, which is a matter of immense importance, as we shall soon see. The extra bulge of the eye constituting the iris and pupil is represented in the cut. The black pigment which abounds in the choroid of all ordinary eyes is absent in the eyes of albinos and rabbits, and hence their reddish appearance as the unconcealed blood of the capillaries of the choroid and iris thus become visible.

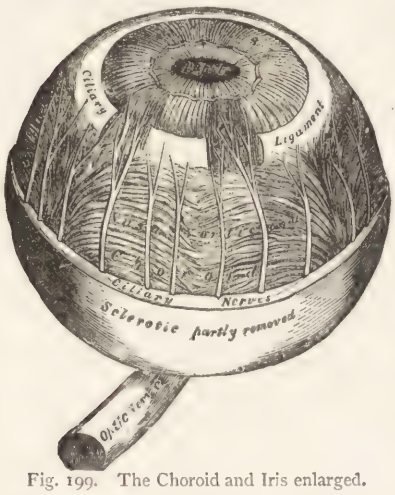


Fig. 199. The Choroid and Iris enlarged.

5. *Refractive Media.* The cornea, aqueous humor, crystalline lens and vitreous humor constitute the refractive media of the eye. If the habits of life are gross, with too much rich and greasy food, tobacco and stimulus, and too little exercise, air and sunlight, these media frequently become clouded and impure, and the vision consequently impaired.

6. *The Color of the Eyes* which is manifested in the iris, is never absolutely *blue* or *black*, as it is generally called, but rather *blue-gray*, *dark*, or *dark gray*, etc. This color sometimes forms a chemical affinity with the general system; thus a system in which the warm red principle is predominant, giving red or light colored hair and rubicund complexion will usually have a bluish cast of eyes. In such temperaments the arterial blood is rather active. In the case of brunettes, however, in which the dark principle rules more in the hair and complexion, the eyes usually carry out an analogical harmony with the body, and are dark also.

7. *Adjustment to Distance.* In a camera obscura when the lens is adjusted for a certain distance, it will not give a distinct picture for any other distance, but the focal distance must be made longer or shorter by a sliding arrangement according to the location of the object. But as the lens of the eye cannot thus slide outward and inward to suit distances, what shall be done to keep our vision clear? Nature obviates the difficulty by flattening the crystalline lens in proportion as objects are distant, and letting it shrink up into greater thickness as objects are near. The reader must remember that this lens is circular like the double convex glasses in a pair of spectacles when round, only it is immensely elastic, while all around the edges it is encircled by a membrane or suspensory ligament which is like a plaited ruff. Attached to this is the ciliary muscle, containing a great number of fibres (see fig 199), which under the influence of the ciliary nerves is made to contract or expand and thus modify the shape of the lens itself so rapidly and easily that we are scarcely conscious of the process.

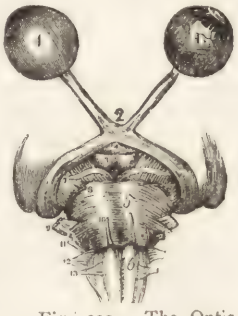


Fig. 200. The Optic Nerves. 1, 1, the two eyeballs. 2. Chiasm of Optic Nerves. 3. Corpora Albicantia. 4. Infundibulum. 5. Pons Varolii. 6. Medulla Oblongata. 7, 8, 9, 10, 11, 12, 13, are respectively the 3d, 4th, 5th, 6th, 7th, 8th, and 9th pair of nerves.

8. *The Optic Nerve.* Fig. 200, shows the *chiasm* or union of the two optic nerves at 2 by means of which the two actual images, one on each retina, which are produced by the external light, are blended into one. At that place a partial decussation occurs and the nerve fibres have been compared to the

four lines by which two horses are guided, the lines of each side passing, to both horses. "Some fibres cross from the retina of one eye-ball to the other; some from one side of the brain to the other; some from the eye on one side to the brain on the other; and some from each eye to the same side of the base of the brain." (Hartshorne.) Huxley does not consider the *Olfactory* and *Optic* Nerves as true nerves, but rather "processes of the brain. The olfactory pair are prolongations of the cerebral hemisphere; the optic pair, of the walls of the third ventricle; and it is worthy of remark, that it is only these two pair of what may be called *false nerves* which arise from any part of the brain but the medulla oblongata—all the other true nerves, being indirectly or directly traceable to that part of the brain, while the olfactory and optic nerves are not so traceable." "It is generally admitted by physiologists," says Dr. Sherwood, "that the optic nerves terminate in the *corpora quadrigemina*, which are, in fact, their proper ganglia." The corpora quadrigemina are in close proximity to the third ventricle.

II. The Retina Considered in Detail

1. *Microscopic View of the Retina.* The retina is a membrane so thin that it would require from 80 to 200 of them to make an inch in thickness, according to which part of it we consider, and yet when looked at through the microscope we find it a little world of wonders. I have drawn fig. 201 from Henle, which is approved and adopted also by Helmholtz. This, at first sight, looks a little like a combination of hills, valleys, ravines and rocks, but the whole could be nearly covered by a good sized pin head, and constitutes the main part of the *yellow spot* in the middle of the retina, at 14, fig. 197, where alone is the point of perfect vision. In order to the finest chemical action nature has created a fine variety of the blue-gray fibrous matter and reddish-gray ganglionic cells extending from the inside *limiting membrane* at 1, which comes in contact with the vitreous humor, to the *cones and rods* at 7, which constitute the outside of the retina. I say *cones* and *rods*, although the rods are omitted for want of room. The cones here are less than a 10,000th

part of an inch in thickness, and the rods are still more slender. Each rod and cone has its own nerve-fibre which passes on through the optic nerve to the brain, and Helmholtz states that there are a quarter of a million of these nerve fibres connected with the retina. Considering that there is not only this vast number of nerve fibres, but various veins, arteries and other matter passing through the optic nerve, which is about the size of a pipe stem, we may see with what an amazing refinement nature developes her processes, dealing with an infinity of objects as easily as with a single one. I will quote a passage from Helmholtz, descriptive of the retina, and of this cut :—"We must now speak of the curtain which receives the optical image when brought to a focus in the eye. This is the retina, a thin membranous expansion of the optic nerve which forms the innermost of the coats of the eye. The optic nerve is a cylindrical cord which contains a multitude of minute fibres protected by a strong tendinous sheath. The nerve enters the apple of the eye from behind, rather to the inner (nasal) side of the middle of its posterior hemisphere. Its fibres then spread out in all directions over the front of the retina. They end by becoming connected, first with *ganglion cells* and *nuclei*, like those found in the brain, and secondly with structures not elsewhere found, called *rods* and *cones*. The rods are slender cylinders ; the cones, or bulbs, somewhat thicker, flask-shaped structures. All are ranged perpendicularly to the surface of the retina, closely packed together, so as to form a regular mosaic layer behind it. Each *rod* is connected with one of the minutest nerve fibres, each cone with one somewhat thicker. This layer of rods and bulbs (also known as *membrana Jacobi*), has been proved by direct experiments to be the really sensitive layer of the retina, the structure in which alone the action of light is capable of producing a nervous excitation.

"There is in the retina a remarkable spot which is placed near its center, a little to the outer (temporal) side, and which from its color is called *the yellow spot*. The retina is here somewhat thickened, but in the middle of the yellow spot, is found a depression, the *fovea centralis*, where the retina is reduced to those elements alone which are absolutely necessary for exact vision. Fig. 201, from Henle, shows a thin transverse section

of this central depression made on a retina which had been hardened in alcohol. 1. (Lamina hyalina, membrana limitans) is an elastic membrane which divides the retina from the vitreous. The bulbs (seen at 7) are here smaller than elsewhere, measuring only the 400th part of a millimeter in diameter, and form a close and regular mosaic. The other more or less opaque elements of the retina, are seen to be wanting, except the corpuscles (6) which belong to the cones. At 5 are seen the fibres which unite these with the rest of the retina. This consists of a layer of fibres of the optic nerve (*n*) in front, and two layers of *nerve-cells* (2 and 4), known as the internal and external ganglion layers, with a stratum of fine granules (3) between them. All these parts of the retina are absent at the bottom of the *fovea*

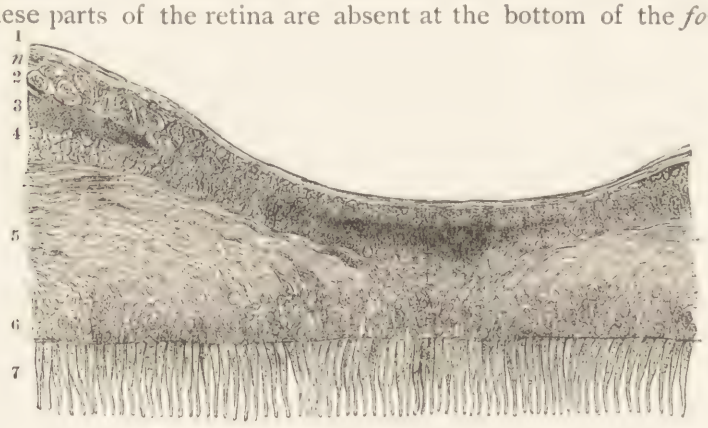


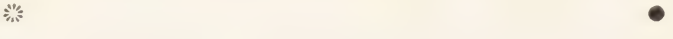
Fig. 201. The Fovea Centralis, or Pit of the Retina.

centralis, and their gradual thinning away at its borders is seen in the diagram. Nor do the blood vessels enter the *fovea*, but end in a circle of delicate capillaries around it. This *fovea* or pit of the retina, is of great importance for vision, since it is the spot where the most exact discrimination of distances is made. The cones are here packed most closely together, and receive light which has not been impeded by other semi-transparent parts of the retina. We may assume that a single nervous fibril runs from each of these cones through the trunk of the optic nerve to the brain, without touching its neighbors, and there produces its special impression, so that the excitation of each individual cone will produce a distinct and separate effect upon the sense." (*Popular Lectures on Scientific Subjects, by H.*

Helmholtz, p. 207, including "*Recent Progress in the Theory of Vision.*")

2. *Luminous Effects of Pressure.* When a pressure is caused over or near the eye, or when an electrical current is sent through the eye, many persons can see a variety of colors or flashing effects. We have seen that these effects always come from some grade of light, in some cases doubtless from odic light. It is reasonable to suppose, also, that the ordinary grade of light may effect the rods and cones of the retina, sufficiently to give to most persons impressions of light by arousing through friction, pressure or electrical currents, a grade of ethers similar to those used in the production of light. But those who are developed to see the odic and higher lights see these colors with incomparably greater vividness and diversity than those who are not. This is especially true in my own experience. Before being able to see these higher grade colors, I rarely ever saw any glimpse of color, with my eyes closed, even under pressure, but since the development of this vision I can see them vividly, on the merest touch, and still more vividly by closing my eyes and *looking* in a single direction for some time. Some persons are not conscious of ever having seen these colors.

3. The *Blind Spot* of the retina lies directly at the entrance of the optic nerve. This blindness comes from the absence of cones and rods at that point, and perhaps somewhat from the greater number of blood-vessels which concentrate there. The reader may experiment on the following star and dot. Hold the



book a very few inches from the eye; then close the left eye and look with the right at the star; the dot will also appear. Now gradually move the book back, and before it reaches the distance of quite a foot, the dot will vanish altogether. Move it a little farther and it will appear again. Close the right eye and look at the dot with the left and the same phenomena will appear.

4. The *Rods and Cones* are the more direct functions by means of which the impressions of light are formed, while the nerve fibres like all others in every part of the system are simply conductors of these impressions to the brain, after reaching

which the full *sensation* of light is produced. This is evident from the fact that the blind spot is full of nerve fibres, but has no cones or rods, while the yellow spot is full of close set cones, but has no nerve fibres at all at one point. Other facts could be adduced in proof, but these are sufficient here.

III. The Sensation of Sight.

1. *The Sensation of Seeing an Object* includes the following things: 1st, the object itself with its form, size, color and position; 2dly, light reflected or projected from the object into the eye; 3dly, the image carried by this light, received as a finer inverted picture, and then repelled onward through the optic nerve fibres by means of the rods, cones and ganglionic nerve cells; 4thly, this inverted and exquisite image again received at the great inner pole of the brain at the third ventricle; 5thly, this image is reflected once more from the third ventricle, to all the phrenal organs in the gray matter of the brain (see Chap. Tenth, XVII), for them to take cognizance of according to their character. That the *sensorium* is in the reddish-gray matter of the outer brain near the junction of the white matter, is almost a certainty, as all physiologists admit that sensation and intellect reside in this gray matter, while from the principles of chemical affinity we may know that the greatest action would naturally occur where the two affinitive kinds of matter join.

2. How can we see objects in their right position as long as it is well known that all images received upon the retina must be inverted both vertically and horizontally, that is the top of an object must be at the bottom of the retina and its right side at the left of the retina, and vice versa? This has been a puzzle for ages and is still unsettled. Those who are unfamiliar with optics may see the process by which an *arrow*, for instance, will have its image inverted through the refracting media of the eye, by looking at fig. 202. It is often said that we learn to see things right side up by experience, which is quite absurd, as we may look at a thing for fifty years and we cannot make it look different from what it is, however much we may think it ought to look different; thus we cannot make black look white, or a circle turn into a triangle, or the left side of ourselves seem

other than the right side when we look into a mirror, for all things do not exist merely in the mind or its fancies, whatever our idealistic dreamers may think. It seems to me that the revelations of this finer vision give us the key to this mystery, inasmuch as they show us that the different mental and sensory forces go to the centre of the brain at or near the 3d ventricle, which is a great radiating as well as receiving center, and being there reflected to all parts of the external brain through the countless fibres of the white substance, the image becomes thus *reinverted*, so to speak, and assumes its proper position. This last reflection, it should be understood, is a finer grade of light than the outward, for the outward light stops at the retina, and

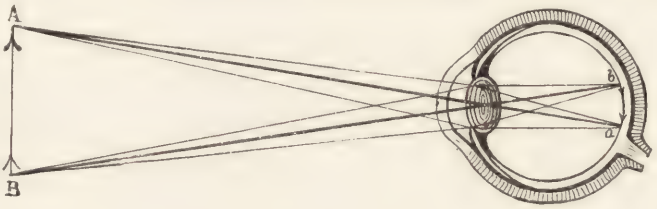


Fig. 202. Inversion of Objects upon the Retina.

only the finer interior light which it sets in motion can pass on to the sensorium in the brain, just as the odic light which magnetism or sunlight sets in motion can pass on beyond these elements, as shown by Reichenbach, and by this work. I have already illustrated this refining process by Bell's Telephone, which by the aid of a diaphraghm and magnet is able to convert the coarser waves of the human voice into the finer electric waves which pass along the wires. Such, too, is the process of hearing and of all other sensations, as we cannot influence the exquisite domain of intellect and consciousness without the use of ethers correspondingly exquisite. Huxley says that the "optic pair of nerves are prolongations of the walls of the third ventricle." If so, the exquisite images painted by light on the retina are carried very directly to the great central pole.

IV. The Perception of Colors.

1. *How Tones are Perceived.* In the "spiral staircase," of the cochlea of the human ear, according to Dr. Austin Flint, Jr., there are 3500 outer rods of Corti, and 5200 inner rods, which,

resembling the keys of a piano, are supposed to take cognizance of pitch in music as they certainly vary in size and length. There is also a great variety of hair-like appendages to nerves which Helmholtz conjectures are made to give vibrations that answer to the external sounds, and are connected with the rods of Corti.

2. *How Colors are Perceived.* In much the same way, as suggested by Helmholtz, the almost countless rods and cones that line the outer surface of the retina, are presumed to receive different grades of colors, and to convey them by about 250,000 nerve-fibres to the brain. Thus we may suppose a large number of rods and cones of a character to receive all the grades of red, a large number more for red-orange, orange, yellow-orange, yellow and all other colors. However much man may advance in the perfection of his faculties in a future and more complete state of being, he would seem to have a sufficient basis for the whole even in the present life. "Max Schultz," says Helmholtz, "has discovered a structure in birds and reptiles, which manifestly corresponds with what we should expect to find. In the eyes of many of this group of animals there are found among the rods of the retina, a number which contain a red drop of oil in their anterior end, that, namely, which is turned toward the light; while other rods contain a yellow drop, and others none at all. Now there can be no doubt that red light will reach these rods with a red drop much better than light of any other color, while yellow and green light, on the contrary, will find easiest entrance to rods with the yellow drop. Blue light would be shut off almost completely from both, but would affect the colorless rods all the more effectually. We may, therefore, with great probability, regard these rods as the thermal organs of those nervous fibres which respectively convey impressions of red, of yellow and of blue light" (p. 251). I have quoted the above to show the great value of the idea as illustrating a great law of vision, and the great error of the idea of supposing that a red element in the rods and cones would attract red light a yellow element, yellow light, etc. In Chapter Fifth, XX, we have seen what an overwhelming array of facts there is to show that in a perfectly free interaction of forces, colors which have a chemical affinity for each other attract, while those which are

alike repel, as illustrated in XIX of the same chapter. A seeming exception to this rule is found in some kinds of colored glasses, such as yellow glass which allows the yellow light to pass most freely, and so with some other kinds of glass, and this evidently because there is a lack of freedom in the interaction of forces. Cobalt, in cobalt blue glass, is primarily reddish, and we have seen the facility of uranium yellow to attract the dark violet and trans-violet, and we will find even glass will allow the affinitive colors to pass with much freedom, while in the wonderfully sensitive portions of the retina we can look for the perfection of chemical affinity, that is, the red principle in the rods and cones must attract and receive the blue element of light; the yellow principle, the violet light; the blue principle, the red; the indigo principle, the orange, etc. I have been all the more particular in explaining this law because it makes absolutely simple various phenomena of vision which the whole scientific world, so far as I know, from not understanding the laws of chemical affinity, have failed to see, the acutest minds having been led into the theories with reference to the matter which I think they would not maintain for a moment, could they see any other way out of the difficulty.

3. *The Application.* We have already seen in Chapter Fifth, how Sir David Brewster would with his left eye open see *orange*, with it shut he would see *indigo;* with it open again he would see *red*, with it shut *sky-blue;* with it open he would see *yellow;* with it shut, *pinkish blue*, which is only another name for light-violet, etc. In other words, the *rods* of his retina, with which he received orange, reacted after his eye was closed and gave out its affinitive color, indigo; the *blue rods* with which he received red, vibrating after his eye was shut he saw blue, and so with all the colors. The rods themselves may not manifest their red, or blue or other principles always to the eye, but this is not necessary any more than it is for oxygen to manifest its blue principle to the eye although it is really prominent. But the opticians, noticing that when they look at a certain color a few moments and then look away or close the eyes, the contrasting color will appear, have concluded very strangely that the nerves that were first used become so fatigued that they can no longer see in the same way. Scherffer, I believe, first advocated this

idea of *fatigue;* then Chevreul, Helmholtz, Tyndall, and all the rest of the writers, both European and American, have followed in the same track. Notice the following from Helmholtz: "When the entire retina becomes tired, as when we spend some time in the open air, in brilliant sunshine, it becomes insensible to weaker light, so that if we pass immediately into a dimly-lighted room we see nothing at first; we are blinded, as we call it, by the previous brightness. After a time the eye recovers itself, and at last we are able to see, and even to read, by the same dim light which at first appeared complete darkness." This philosopher found this matter all reasoned out for him and so did not stop to think for himself, or his keen perception would have perceived its incorrectness in a single minute. He must know that a healthy eye can remain all day in the out-door light without fatigue, and it would seem as if he must know that when the eye is surrounded by bright light, the pupil at once closes up so nearly as to shut out much of the light, so that the streams that strike the retina may not be too severe, while in a dark room the pupil expands widely before enough light can be admitted to see objects plainly. It is clear enough that if one comes in from a bright light with the pupil almost closed, his eyes cannot at first receive light enough to see until the pupil has had time to expand. Every child, I suppose, has laughed to see how the pupil of a cat's eye will close up when a light is held near it, and expand when held farther off, and human eyes work on the same plan only with less rapidity. The cause of this seems evident enough, and is provided for by nature in the following skilful manner: When any light becomes very intense, the yellow is predominant which, being thermal and expansive, causes the sensitive retina to expand, and this by a reflex action causes the iris to widen until the orifice of the pupil becomes almost closed; when the light is removed, the stimulus ceases and the iris contracts until the pupil becomes large. But the fact that a human pupil cannot expand quite so rapidly as a cat's and consequently must blind him a little when he passes from a bright to a dark place, should not lead Helmholtz and Tyndall to suppose that the retina is in any way fatigued.

4. Helmholtz considers that the foregoing shows how the whole retina may become fatigued. Farther along he says:

"It is possible to produce a partial fatigue of the *retina* in another way. We may tire it for certain colors only by exposing either the entire retina, or a portion of it for a certain time (from half a minute to five minutes) to one and the same color. According to Young's theory, only one or two kinds of the optic nerve fibers will then be fatigued, those namely which are sensitive to impressions of the color in question. All the rest will remain unaffected. The result is that when the after image appears red, we will suppose, upon a gray back ground, the uniformly mixed light of the latter can only produce sensations of green and violet in the back part of the retina which has become fatigued by red light. This part is made red blind for the time. The after image accordingly appears of a bluish green, the complementary color to red. It is by this means that we are able to produce in the retina the pure and primitive sensations of saturated colors. If, for instance, we wish to see pure red, we fatigue a part of the retina by the bluish green of the spectrum, which is the complementary color of the red." Having thus reasoned from false premises he concludes that "the quality of our sensations and especially of our sensations of sight, does not give us a true impression of the corresponding qualities in the outer world," and "does not, as we now see, at all depend upon the nature of the external object, but solely upon the central connections of the nerves which are affected." We may thus see how misapprehension of the real facts of nature may lead even such eminent minds into a theory which makes all things, especially connected with sensation, a mere subjective matter. We have seen that even these after effects, when the eyes are closed or when we look at a different color, are simply reactions on chemical laws, caused by the external color itself, so that the subjective and the objective, force and matter, action and reaction, the positive and the negative must forever act side by side, or not act at all.

5. *Another Mystery of Vision* is solved by the direction of the fine forces which, as we have seen, enter more decidedly on the left side of the brain and emerge on the right. The following language is from Brewster's Optics, p. 434 :—"On uncovering my right eye and turning it to a white ground, I was surprised to observe that it also gave a colored spectrum,

exactly the reverse of the first spectrum (seen with the left eye), which was *pink* with a *green* border. The reverse spectrum was a *green* with a *pinkish* border. This experiment was repeated three times and always with the same result, so that it would appear that the impression of the solar image was conveyed by the optic nerve from the left to the right eye. Sir Isaac Newton supposed it was his fancy that transferred the image from his left to his right eye." The foregoing is a striking confirmation of the etherio-atomic process which gives colors in one direction exactly the contrast of those in the other. He sees pink surrounded with green with the left eye, then on shutting the left eye and gazing on a white ground with the right, sees green surrounded with pink, just as we might expect, as illustrated in fig. 49. The first part of the experiment is given in chapter Fifth, XX, 16.

6. *Color Blindness* may be caused by the imperfect working of a portion of the rods and cones of the retina, or from the fact that the humors of the eye may be absorptive of certain colors and thus must prevent them from passing on to the retina and brain. Some can see only yellow and blue ; some will look at the spectrum and see only a dim spot on the place of the red ; some can distinguish only white and black, having no distinct perception of chromatic hues ; some cannot tell a red from a blue, or purple fruit from the green leaves, and a red blind Scotch clergyman was about to buy scarlet cloth for his gown supposing it to be black. Many persons are unfit attendants at railway stations from their inability to distinguish the color of signal lights. In Edinburgh color blindness affects over 17 per cent. of the population ; in England, 8 to 12 per cent., in Prussia 12.5 per cent., in Russia or Sweden a much larger percentage. It will be found that in all cold climates like those of Scotland, Russia, Sweden, Siberia, etc., color blindness and ordinary blindness are common on account of the glare of snow in the winter, and of almost constant sunlight in the summer, from the shortness of the nights. M. Wartmann says that color blindness is found only among individuals of the white race, and that but few females are deficient in the perception of colors.

V. Diseases of the Eye.

1. The human eye, wonderful as it is, and founded on a marvelous perfection of design, is liable from our ignorance or carelessness, or some inherited conditions, to get out of order. In fact its very complication of parts and exquisiteness of finish render it the more easily injured. A watch, from its delicate machinery, must be handled more carefully than a hoe, but the eye, with machinery a thousand times more delicate than the watch, and with forces a million times swifter than any of its springs, would at once fall into ruins were it not constructed with vastly more skill than any workmanship of human ingenuity. As it is, it has sometimes been known to run nearly a century without much impairment, and the wonder is that, from its over use, and the reckless habits of living, there are not far more diseases of the eye.*

2. I will give some of the Leading *Diseases of the Eye*, or deficiencies of vision. *Near-sightedness* or *Myopia*, is the most common imperfection, and results from too great a convexity of the crystalline lens, or from too great a length of the eye-ball anterio-posteriorly, either of which conditions brings the rays to a focus before they reach the retina. A process of flattening the eye by pressure has been recommended in myopia.

3. *Long-sightedness* or *Presbyopia*, comes from a condition of the lens, or eyeball, exactly opposite that in myopia. Old age, drying up the humors of the eye and the fulness of the lens, ever tends to flatten the eye, and thus induce presbyopia, which must be remedied by convex glasses, just as myopia requires concave glasses.

4. *Strabismus*, or squint, is a lack of parallelism in the motion of the eye, and comes from some paralysis or spasmodic action of the muscles which move the eye. The more common forms are *convergens*, or a turning inward, and *divergens*, or a turning outward. A person strongly charged with vitalizing

* The Rev. Abner Smith, a grandfather of the author, could read ordinary print without spectacles readily after he had become a nonogenarian, and this could probably be accounted for from the fact that his temperate life, correct food, out-door exercise, and bathing, were such that he never experienced a day of sickness in his life. I have noticed the account of some that are centenarians who could read without artificial help.

force may sometimes animate and regulate these muscles with the ends of the fingers, and sometimes surgery is required.

5. *Amaurosis*, is nerve-blindness, or paralysis of the optic nerve. A magnetic hand laid on each anterior portion of the temples, a little back of the eye, may prove vitalizing and curative, as the optic nerve is reached thus. I have cured *inflamed* eyes by putting cool wet fingers over the same region.

6. *Cataract* is the opacity of the crystalline lens, or its capsule, or more frequently of both. It is sometimes cured by vital magnetism, sometimes by electricity, and is most frequently operated upon by surgery. *Muscæ volitantes*, are the flitting effects caused at times by minute fibres which float in the vitreous humor.

7. *Astigmatism* is unequal refraction in various parts of the eye; *Hemeralopia*, is night-blindness; *Nyctalopia*, is day-blindness; *Asthenopia*, is weak sight or partial blindness following the continuous looking upon one object, etc.

8. When any of these diseases commence manifesting themselves it should be a special signal for purifying the blood, avoiding rich and greasy foods, animating the whole system by electricity, manipulation, out-door exercise, shading the eyes, or using bluish light in case of irritation, etc.

9. *Artificial Lights*, having more of the yellow and orange principle of carbon than sunlight, are more irritating to the eyes, and tend to cause ophthalmic or inflamed conditions. I quote the following practical remarks from Dr. Forbes Winslow:— "Persons exposed for an undue length of time to the glare of brilliantly lighted rooms, often suffer from chronic ophthalmia and other affections of the organ of vision. Literary men, from the same cause, are liable to attacks of *muscæ volitantes* and amaurosis. Tailors, seamstresses, shoemakers, jewellers, watchmakers, and, in fact, all who work by artificial light, are subject to serious disorders of the eye. Under these circumstances they often become acutely sensitive to light. According to a distinguished oculist, light is injurious to the eyes in proportion as the *red* and *yellow* rays prevail. These produce cerebral and visual excitement, followed by debility of the retina. He suggests as a remedy for the injurious effects of red and yellow colors that the light should be surrounded by a shade

tinted blue on its inner surface. The blue rays reflected from it will produce a tolerably pure and white light, by their union with the reddish yellow rays of the flame. To effect the same purpose the lamp should be enveloped by a glass chimney tinged inside with a very pale blue, or the light should be made to pass through a fluid of the same color." A still better arrangement has been devised by a New York firm * called the "Crystal Light," by means of which every tint, shade, and hue can be employed. This consists of a metal frame, fig. 203, in which are set rods of crystal of any desired color around the light in cylindrical shape. The light blue are very fine for reading, writing, or sewing by, but if it is designed for very weak eyes the dark blue is best. The green rods are exceedingly cheerful as well as soothing to the eyes. The dark blue, for lighting a room, is somewhat gloomy, but would be admirable and very healing for invalids who have neuralgic or inflammable conditions. A most excellent arrangement, especially for wall burners, would be to have the transparent crystal rods on one side of the light, and have these merge into violet, and then blue for the other side. For sewing, writing, or for weak eyes, the blue side can be turned outward, while for lighting the room, in a social circle, the transparent side would be best. These lights apply to oil as well as gas burners, and reflect so much light downward that paper or sewing material can be illuminated brightly, while the eye itself is in soft light. To add beauty the rods are twisted into spiral and other graceful forms, which, by their refracting power, give something of the diamond sparkle. A very excellent feature about this light is that its cylindrical shape formulates currents of atmospheric oxygen, which, being drawn in upon the flame, greatly increases its brilliancy, and de-



Fig. 203. The Crystal Light.

* Deutsch & Co., 770 Broadway; kept also at 306 Regent St., London, and 22 Rue St. Martin, Paris.

stroys the flickering character of gas light. In speaking of this I have no possible interest except the good of the public, and shall freely welcome anything better which may be produced

VI. Conclusion.

1. It is time now to close this work, which has been an attempt to explore some of the finer realms of the universe and gain some new illumination concerning nature and human life. For my reader, who has followed me carefully through all this long pathway, dwelling with candor and a truth-loving spirit upon the array of facts and principles, I confess to a feeling of affection. For those who take up this volume with a somewhat carping, dogmatic spirit, and skipping over it superficially here and there without seeing the connected whole, I have a feeling of sorrow, confident that they will injure themselves and a good cause more than they will me. For those also who are indignant that I have dared to leave old beaten tracks and attack pet theories, I trust I have due sympathy, for they stand where I myself stood sometime ago, before I had become large enough to see more than one side of truth. It is sad to have to offend people by attacking their pet theories, or their pets of any kind, but when I see people making a pet of a rattlesnake, I feel like warning them of their danger, and especially if I see them taking to their heart a falsehood, I will warn them of that which is still more dangerous than the rattlesnake, and I would be unkind not to do so. In passing this book over to the world, I would say that it will be grief indeed if, by my writings, I shall ever mislead any of my dear fellow-beings, for they are already quite enough befogged with darkness and superstition, and on the other hand it will be a joy unspeakable if I can guide many upward into higher and holier light.

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